WORK

An Illustrated Journal of Practice and Theory

FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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VOL. IV.—No. 185.] SATURDAY, OCTOBER 1, 1892. [PRICE ONE PENNY.

WORK WORLD.

ONE of the Nevada salt mine beds covers 15,930 acres. The bed is solid rock salt.

* *

Over sixty tons of freestone have been landed as material for the new lighthouse to be erected on Helliar Holm, in String Sound, at the entry of Kirkwall Bay.

* *

Wages of seamen in Australia are being reduced to £6, and those of firemen to £8, per month—with discontent and even a little rioting.

* *

Not content with having a perfect model of the Forth Bridge at the World's Fair, an idea is on foot to reproduce the St. Gothard Tunnel. Go on, America!

* *

An ingenious and economical arrangement for watering streets by electricity is in use in America. The machine—in the form of a street car—ensures a rapid and regular sprinkling.

* *

Petroleum mixing with sewer gas becomes an explosive. Officials should be warned in time not to allow petroleum to enter sewers. If it does so by accident the sewers should be flushed out.

* *

"General" Booth lives and works on about a shilling a day! This ought to be cheering to readers of WORK, some of whom, doubtless, have to content themselves with even less.

* *

Tight joints of water and steam pipes may be separated by heating them in a smith's fire. The heat will expand and liberate them. Many a good bend and branch can be saved thus and used over again.

* *

At Providence Works, United States, an engine has been running for nearly fifty years, and is reported equal to a second half century of work. It is one of the earliest engines designed by the late George H. Corliss.

Growth of electric railways in America has been rapid. In 1884 there was only one, now there are 436. Last year they carried 250,000,000 passengers without causing one death. The steam railways caused 5,241 deaths. Underground London companies—note!

* *

A gigantic drainage scheme, promoted by the President of the Tampa Board of Trade, will work a tract of land eighty-two miles long and from three to twelve miles wide along the St. John and Indian Rivers at a cost of £800,000. This ground, when drained, will be available for sugar producing, as the mud is 3 ft. deep all over it.

* *

The sale price of emery is to be fixed periodically by the Greek Government. The industry in this mineral is a State monopoly. The island of Naxos supplies most emery used, but in recent years much has been brought from the neighbourhood of Smyrna. It is found in large blocks, sometimes embedded in limestone.

* *

The difficulty of getting perfectly tight joints with screwed tubes is overcome by using conical threads, which readily adapt themselves to any slight inequality in the tubes, and admit of being screwed up much tighter than the ordinary threads. By means of a special machine the whole thread is produced at one screwing, as in other dies.

* *

The *Birmingham Daily Gazette* and *Weekly Mercury* printing machinery is now driven by electric motors run by a current of 110 volts, furnished by the Birmingham Electric Supply Company. By this arrangement two large machines, each capable of producing 20,000 copies per hour, ready folded, can be started at any hour of the day or night.

* *

Aluminium, instead of steel, for shipbuilding reduces the weight of the hull by one-half. There are five small craft constructed in this material. Three are petroleum yachts built at Zürich, one a Swedish lifeboat, and another a yacht built in England. This material, on account of its strength, incorrodibility, and lightness, is peculiarly adapted for shipbuilding.

* *

The force-power of the Niagara Falls will soon be employed. Two years ago a start was made on the great tunnel, which is to be about a mile and a half long, and about a thousand feet remain to be accomplished. Through this tunnel the water from the river will be conducted to four turbines, from which the power will be distributed electrically.

* *

Work might be found for discharged soldiers and sailors by instituting an entirely new body of public servants—something between the police and commissionaires. They might have a distinctive uniform, and take the place of policemen at all public buildings, etc. Then Sir Edward Bradford's men could be wholly employed in more important and suitable work.

* *

Indiarubber and gutta-percha threaten to become extinct. The former is imitated by a compound of bitumen, benzine, Manilla gum, and resin oil. This is said to stand vulcanising, and also to produce perfect insulators. What about the world's supply of gum, which is being used up at a rate far exceeding production? Modern civilisation depends as much on lacquer and varnish as on macintosh and vulcanite.

* *

The wages earned at the Homestead Iron Works, Pittsburg, U.S.A., are indeed phenomenal, as is shown by the figures below, which have been converted into pounds sterling:—

	Per day of 8 hours.			*Per hour.*		*Per annum of 300 working days.*		
	£	s.	d.	s.	d.	£	s.	d.
Rollers	2	3	2	5	6	647	10	0
Rollers	2	10	3	6	4	760	0	0
Shears helpers	0	17	3	2	2	258	15	0
Heaters.. ..	1	11	9	3	11½	476	5	0
Heaters.. ..	1	12	3	4	0	483	15	0
Heaters.. ..	1	13	11	4	3	508	15	0
Heaters.. ..	1	14	7	4	4	518	15	0
Helpers.. ..	1	3	6	2	11	352	10	0
Cranemen ..	0	19	2	2	5	287	10	0
2nd Cranemen	0	15	6	1	11	232	5	0

Giving an average in earnings of the men, working eight hours per day, of 3s. 9d. per hour, or £452 12s. 6d. per annum.

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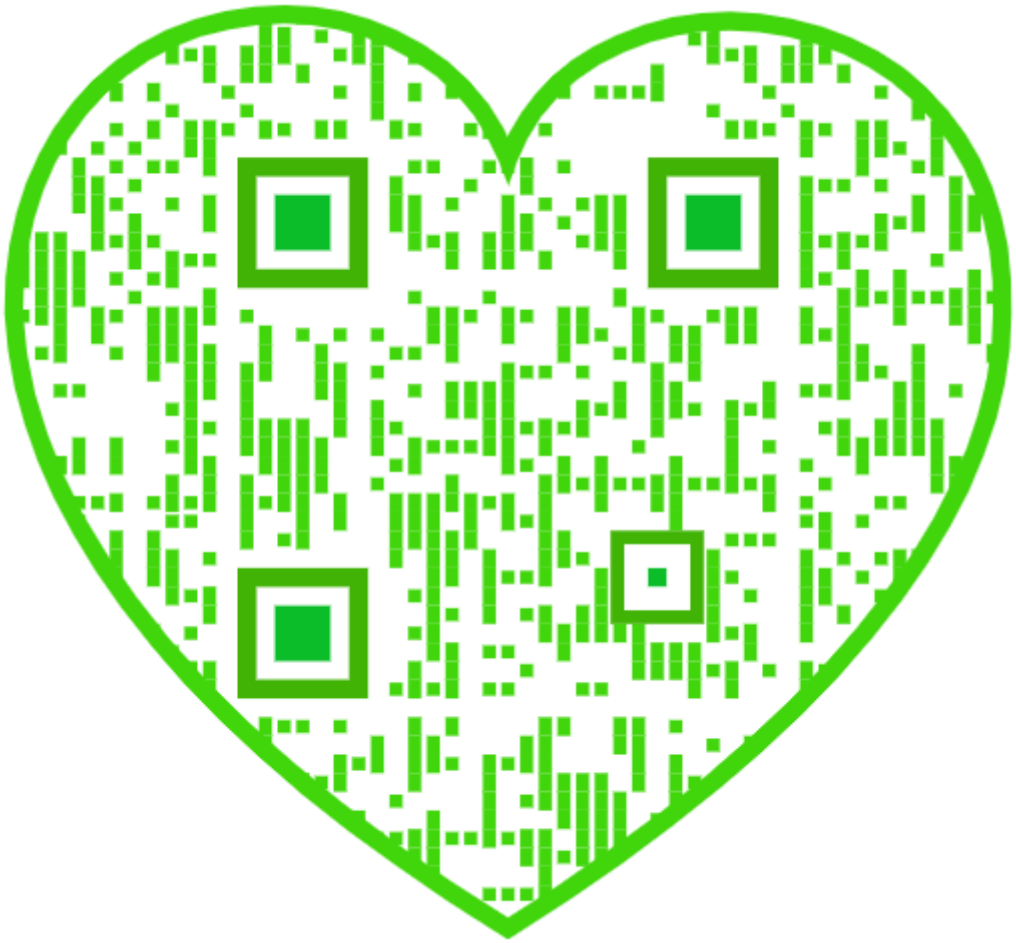

FANCY CONVERTIBLE TABLE.

BY JAMES SCOTT.

INTRODUCTION—ADVANTAGES—THE SUPPORT OF THE FLAPS—THE STOP-PIN—THE FRAMING—THE TRAY—THE TABLE-TOP—CONNECTION—OPTIONAL SPRING.

Introduction.—I do not think I shall be far wrong in gauging the desires of readers by assuming that the small fancy table which I have designed for them in this issue will be received as something acceptable, by reason of being rather new in idea and a trifle fresh in general appearances. For a mere fancy table, capable of being turned out with a reasonably small expenditure of material and labour, nothing could possibly be better; and as the constructive details of the table are so arranged that a convertible table is provided, the frequently unquenched desire for obtaining temporary relief from a general sameness, which sometimes tires a person who possesses a table with parts immovable, is surmounted. Only the sense of change afforded by the temporary conversion of the article would, in many cases, alleviate the unsatisfied feelings which might be caused by it, supposing it were but a permanent fixture, either in the form shown in Fig. 1 or that represented in Fig. 2.

It may seem strange and sentimental on my part to speak of the need of change concerning pieces of furniture; but if each reader will ask himself whether there is not a fancy article which he now owns for which he would willingly accept a substitute, I feel convinced that he would answer in the affirmative. He may have tired of its presence after the ownership of it had extended over a period of but a few months' duration; while, eventually, he may have wondered how he *could* tire of it—the old love would return. I have particularly noticed this trait in humankind; and frequently, when I have shown a new design in a catalogue to a friend, he has remarked: "How much I should like that in place of so-and-so"; and yet previously he had attached his sentiment to the piece of furniture he still possessed. Thus is it ever: human nature—as the sea is always the sea, yet always changing—is always the same, but continually on the ebb and flow. So much for the sentimental side of the question; now for the practical.

Advantages.—In ordinary flap tables it is necessary to raise each flap separately, and adjust a bracket underneath it, in order to support it; and also, in such cases, the respective corners of the flat top remain in the same adjacency with the legs. With my table, however, brackets are dispensed with. One flap would be raised with the right hand, while the under parts were being held with the left hand and the flap moved towards the right, when the top would partly revolve and all flaps adjust themselves, requiring no further support of any kind whatever. The result is that the corners, then pointing in the same direction as the legs, are those which otherwise, as in Fig. 1, lay *between* them. This naturally gives a greater contrast than would ensue did the flaps rise exactly over the area which they occupy in Fig. 1. Moreover, the nuisance occasioned by the use of brackets is entirely obviated.

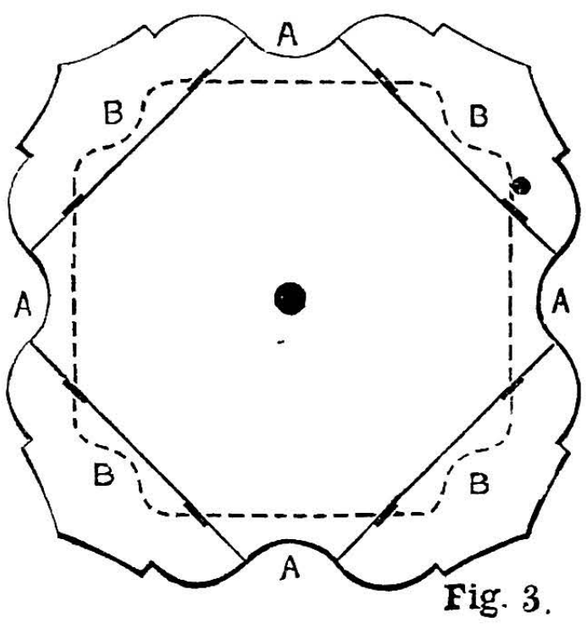

Fig. 3.

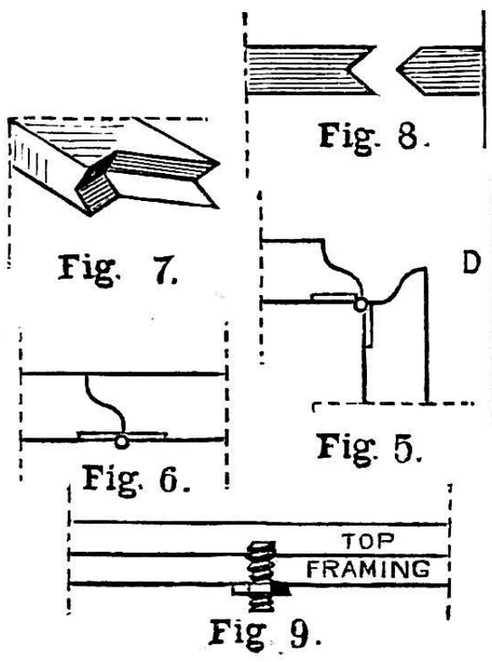

Fig. 7. Fig. 8. Fig. 6. Fig. 5. Fig. 9.

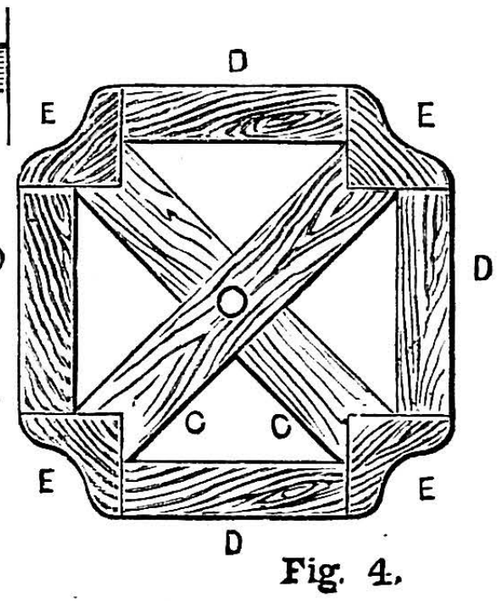

Fig. 4.

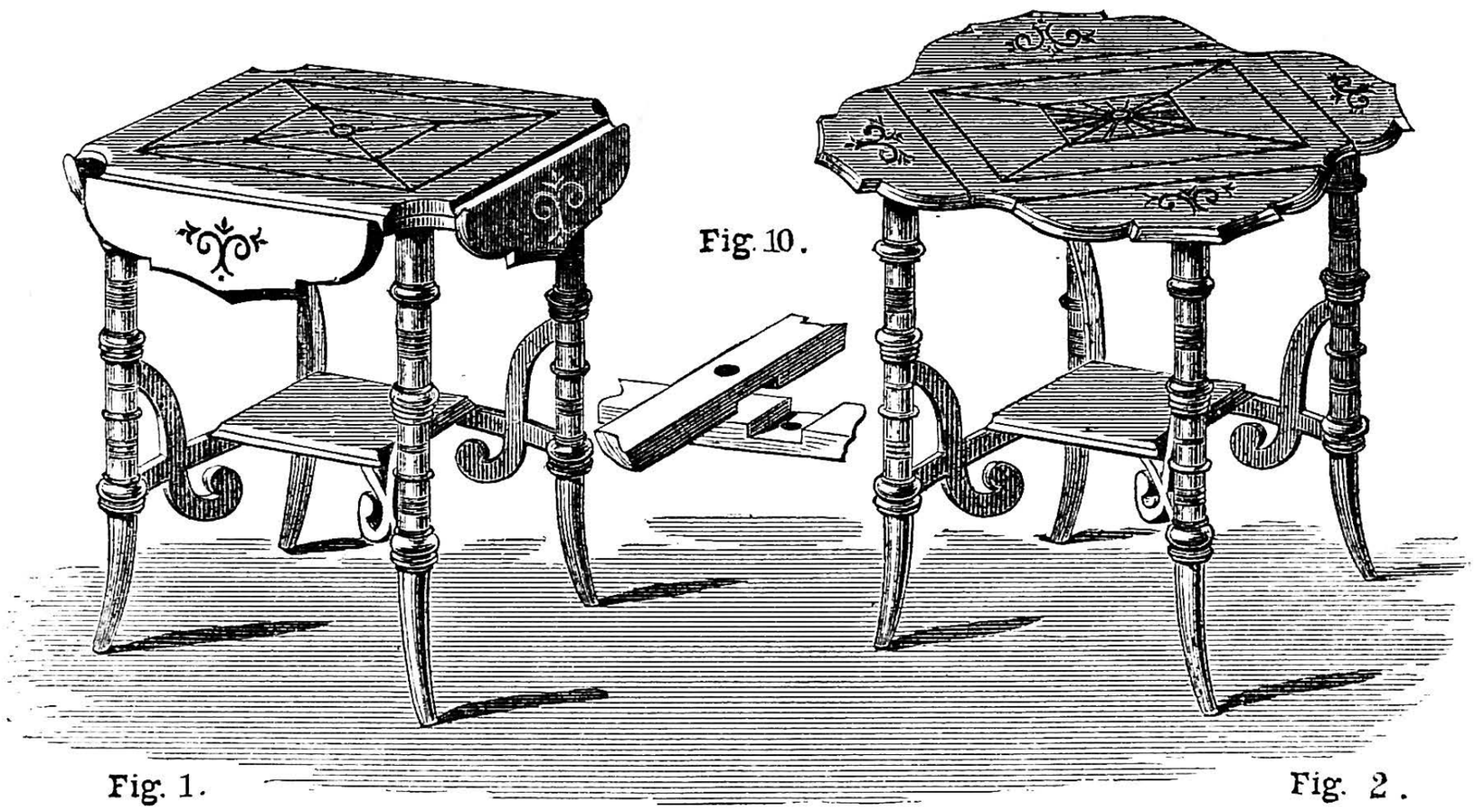
Fig. 1. Fig. 2.

Fig. 10.

Fancy Convertible Table. Figs. 1 and 2.—The two Forms of the Complete Table. Fig. 3.—Plan of Top of Fig. 2. Fig. 4.—Plan of Under Framing. Fig. 5.—Section of Flap and Top. Fig. 6.—Ditto. Fig. 7.—View of End of Cross-rail in Framing. Fig. 8.—Section of the latter End of a Corner Block. Fig. 9.—Elevation of Top and Framing. Fig. 10.—The Halved Cross-rails. (Top Board, 24 in. square; Flaps from Boards, 6 in. wide; Width of Side Pieces of Under Framing, 3 in.; ditto of Cross-rails, 4 in.; Thickness, 1 in.; Legs from 2 in. stuff.)

The Support of the Flaps.—A reference to plan (Fig. 3) will render a clear explanation of the manner in which the top parts are supported when turned. The dotted lines in that diagram represent the outline of the under framing to which the legs are attached. This is pivoted to the almost square top board, in the middle of course, so that the corners A may coincide with the corners B (that is, when the table is as in Fig. 1), or be placed as shown in the diagram in question (when the table appears as in Fig. 2). It will be seen, therefore, that when the flaps are raised they rest upon the corner parts of the under framing, where, not being of large dimensions, they receive all necessary support.

The Stop-pin.—It is advisable that a short pin or dowel be driven into the under side of one of the flaps, for the purpose of restraining the top, etc., from going further round than is desired. Either flap may receive the dowel (the small dot in Fig. 3 representing it), it contacting with the under framing when the flaps are adjusted.

The job will be enhanced in appearance if the edges of the top board are moulded, and the hinged edges of the top similarly treated, to correspond with the top board. Figs. 5 and 6 will explain what I mean.

The Framing.—A method of putting together the framing which is intended to take the legs is made clear in various diagrams, to which further allusions will be made. In Fig. 4 (a plan), C, C are halved cross-rails whose ends are shaped, as in Fig. 7, to fit over the corner-pieces E (see Fig. 8). For the guidance of beginners, I repeat the halving joint, and it is shown in Fig. 10. The rails D should be carefully tenoned into the pieces E. It will not be found at all a difficult matter to secure all parts together. The tops of the leg-blocks should be screwed or dowelled to the under sides of the parts D, further strength being obtained if they are sunk within shallow mortises. The outside ends of the pieces E should be rounded, thereby facilitating the actions of all parts during the adjustment.

The Tray.—So far as the joining of the tray and supporters is concerned, the latter need only be tenoned to the legs, the respective pairs being halved. The opposite end of each plain curved stretcher would then be screwed to the underneath part of the footboard.

The Table-top Connection.—The most desirable way in which to unite the table-top to the under framing will be to fix a screw-dowel, of a few inches length, to the under side of the top board, allowing it to pass down through a hole penetrating the pair of cross-rails, using in conjunction with it a small nut with which to engage it, and render the loosening of the parts an avoidable feature. (See Fig. 9.)

Optional Spring.—A spring may be used in connection with this job, although no

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real necessity exists for the adoption of such. One of the spiral pattern, wound round the revolving pin, should have one end attached to the table-top, and its remaining end to the pin or spindle.

Accommodating dimensions are indicated upon the various diagrams, to which I must refer the reader for particulars.

As readers are aware, the rule with me is to provide designs, the materialisation of which will result in the creation of pieces of furniture possessing many points of utility; but the present article pretends to no further practical use than any ordinary table.

MECHANICAL NOVELTIES: CLOCK AND WATER-WHEEL.

BY F. A. M.

THE figure represents an apparent impossibility. A clock is made in a cylindrical case and placed upon an incline; it does not immediately roll to the bottom, because it cannot do so without setting in motion the train of wheels contained therein, and this train is controlled by a pendulum. The clock then has no spring nor any weight, except that it is itself the weight. The hand does not turn, but remains vertical, so that the top of it indicates the hour upon the dial, whilst the lower end points to the same hour upon the front of the inclined plane. This hand must evidently be attached to a heavy weight hanging within the clock from the centre of the case, and the wheel-train must be between this weight, which does not turn, and the case of the clock, which does. When lifted up from the inclined plane the beat of the pendulum ceases, and when replaced it recommences. To wind up the clock, then, it is only necessary to pick it up and replace it higher up on the incline, so that the figures on incline and dial shall properly correspond.

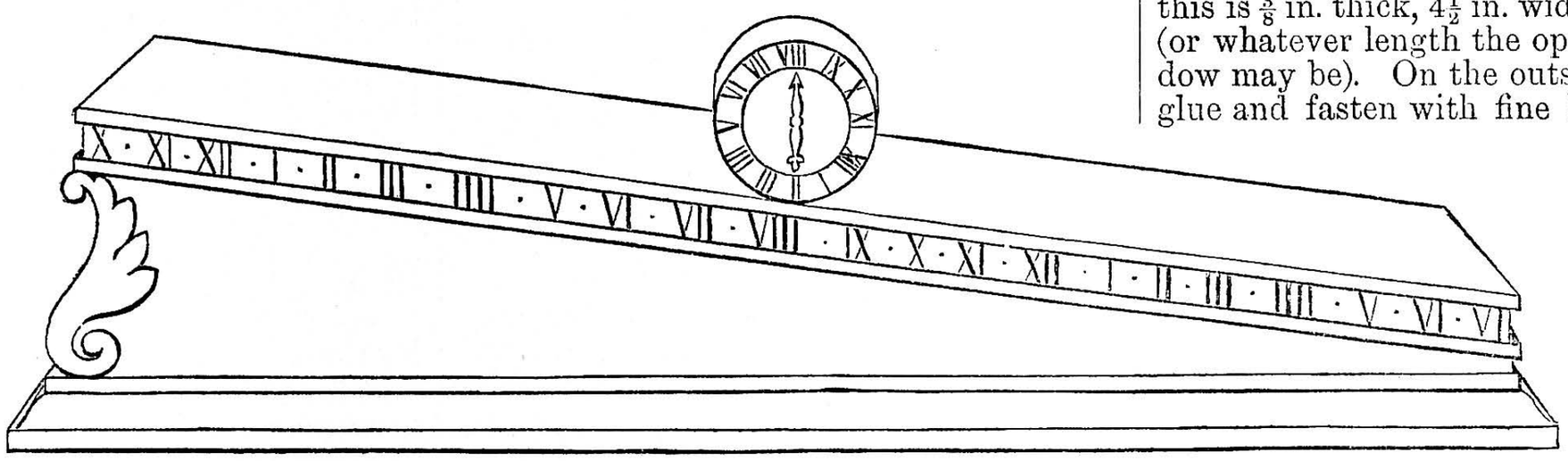

Fig. 1.—Curious Clock, whose Body turns and not the Hand.

This clock is copied from an old French work, dated 1719: "Description du Cabinet de Monsieur Grollier de Servière," which contains many other mechanical curiosities. This one seems worth making, and perhaps some young watchmakers amongst our readers will like to exercise their wits upon it, all the more as no information is given as to the arrangement of the movement. It would seem as if there should be a rack laid down on the incline for teeth cut upon the rim of the clock case to engage in, and a step of some kind provided at the bottom of the incline to prevent the clock from falling off.

Fig. 2 is from the same work, and represents a machine for raising the water of a river to the height of the half diameter of the wheel. The circumference (A) of the wheel is hollow, and is divided by partitions, so as to form so many boxes, which are filled as they dip into the water. In that part of each division which first leaves the water there is a hole (B) through which it can enter, and for delivering the water there is in each division a second hole (C) communicating with a pipe passing along the arm of the wheel, and conducting the water to its hollow axle, through which it passes till it reaches the reservoir (D). The current of the river striking against the float-boards turns the wheel, and each partition of the hollow circumference as it passes through the water lifts a quantity, which, passing through the radial pipes, is discharged through the axle into the reservoir at the height of half the diameter of the wheel.

There seems no reason why an appliance of this kind should not be constructed by a country carpenter or wheelwright; it might be useful in the colonies, and it looks as if it would continue to work for a long time without giving any trouble.

Doubtless there are many of the thousands of WORK readers who may be acquainted with other mechanical novelties which they might bring under the notice of the Editor. He wants to get all the good things he can into WORK, and mechanical novelties especially stimulate the interest of those who think out such things. I would recommend this for the benefit of us all.

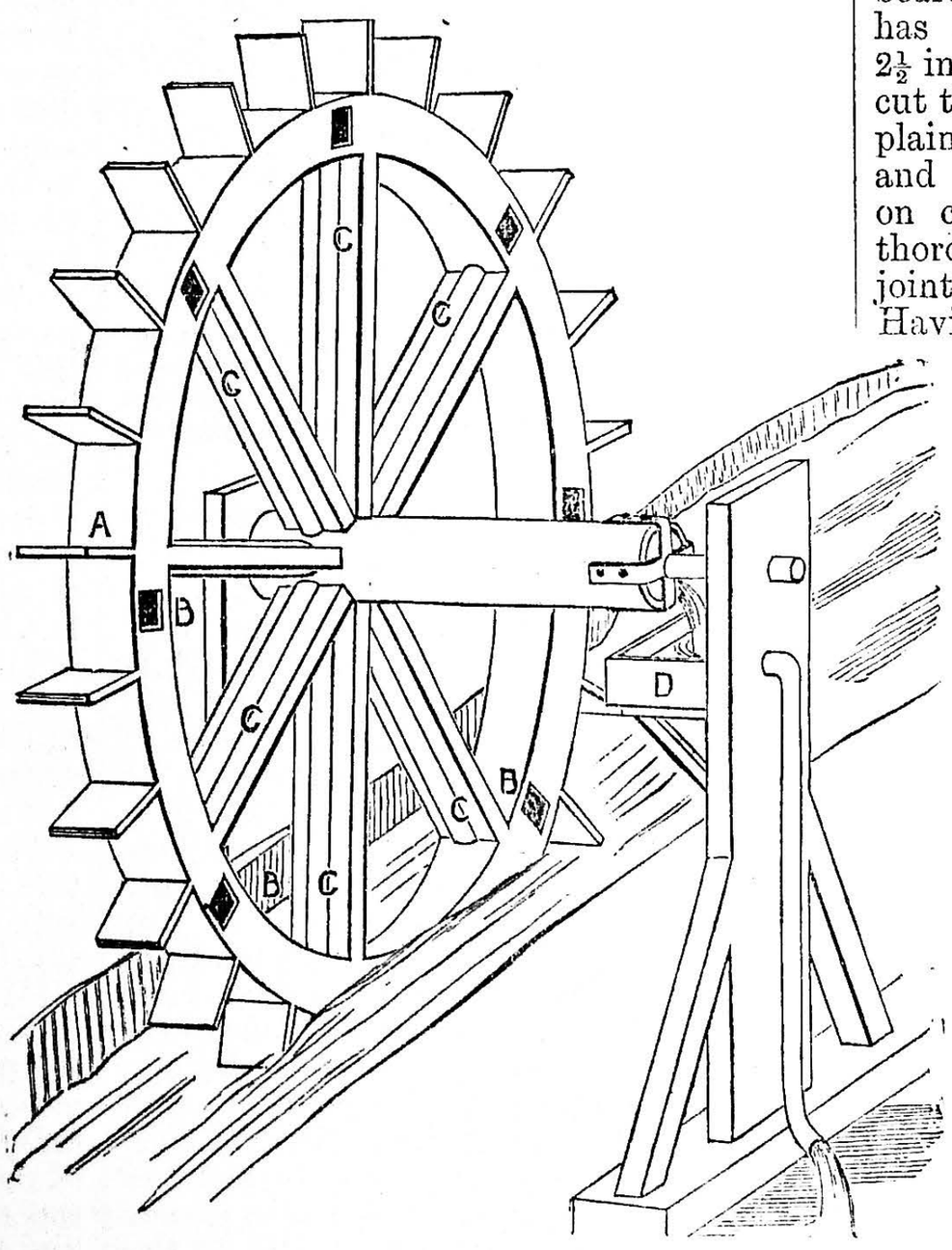

Fig. 2.—Water-wheel for raising Water to Height of Centre.

ÆOLIAN HARP FOR EVERY WINDOW.

BY R. F.

R. B. (*Galashiels*) and other correspondents will read this concerning harp making:—

Æolian harps are of two kinds, the single and double, but very little is gained by having a double harp, except, perhaps, the extra trouble of tuning; and as it is essential that the instrument be kept perfectly in tune, this object can be better attained by making one of the single kind.

The kind mostly in use are about 32 in. long by 5 in. broad and 3 in. deep, but the best effect is to be got from an instrument which exactly fits the window-frame, so that the sash may be shut down close on to the top or wind-board. They are made of yellow pine, with beech blocks at each end for the insertion of the hitch- and tuning-pins, and with two bridges, over which are stretched the strings.

Commence by getting out the bottom; this is $\frac{3}{8}$ in. thick, $4\frac{1}{2}$ in. wide, and 32 in. long (or whatever length the opening of the window may be). On the outside edges of this, glue and fasten with fine brads two pieces, of $\frac{1}{4}$ in. by $2\frac{5}{8}$ in. This will form a trough $2\frac{1}{4}$ in. deep. In each end of this trough fit accurately a block of beech; that in the right end should be 4 in. long, and in the left end 3 in. The grain of these blocks must run in the same direction as the rest of the wood, not crosswise, and the blocks should *exactly* fill the ends up. Glue these in, and cramp up till dry. If no cramps are available, a few brads may be used to hold the sides and bottom to the blocks. When dry and cleaned off, it is ready for the sound-board. This is also made of $\frac{1}{4}$ in. pine, and has a sound-hole cut in the exact centre, $2\frac{1}{2}$ in. in diameter. A ring or fret may be cut to fit this sound-hole, or it may be left plain. Glue and cramp the sound-board on and again leave to dry; but in getting it on care must be taken that the glue is thoroughly clean and quite hot, so that the joint may be as nearly as possible invisible. Having completed the body of the harp, attention may be given to the wind-board. This consists of a piece of $\frac{1}{4}$ in. stuff the same size as the harp, and is fastened at each end to a cross-piece $1\frac{1}{4}$ in. by $\frac{3}{4}$ in., so that the wind-board lies $1\frac{1}{4}$ in. above the sound-board. It must be set upon the harp itself by dowels, so that it may be easily taken off for tuning. Two bridges will also be required. These are made of hard wood, are the width of the harp in length, and are $\frac{1}{2}$ in. high, $\frac{1}{2}$ in. wide at base, and $\frac{1}{16}$ in. at top. They are placed on the sound-board, at a distance of 2 in. from the pegs at each end.

The instrument is now ready for the varnishing. First punch in all heads of brads, and stop up the holes with putty the same colour as the wood, then give all over a coat of size, made of clean glue and hot water, one part glue to six parts water. When dry rub this down with very fine glass-paper; then give another coat of size, and when this,

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too, is dry, give a coat of the best copal varnish, lightly and evenly applied. If the sizing has been properly done this one coat of varnish ought to be sufficient, and the instrument may be set aside in a place free from dust to become thoroughly hard and dry. When this time arrives, draw across the harp, at a distance of $1\frac{3}{4}$ in. from the right end (that is, the one with the longest beech block), a line, and on this line bore six holes, at a distance of $\frac{2}{3}$ in. from each other, the first hole to be $\frac{11}{16}$ in. from the front edge. One inch in advance of this line draw another, and on this bore six more holes which come exactly halfway between those on the other row. These holes should be 1 in. deep, and just large enough for the tuning- or wrest-pins to fit tightly in. They should be slightly countersunk, and inclining to the end at an angle of about 20°. At the other end of the harp, in an exactly corresponding position, drive in two rows of pins, with their heads inclining at an angle of 45° to the left end, and leaving about $\frac{1}{4}$ in. for the attachment of the strings. The wrest-pins are made of No. 6 wire B.W.G. (dulcimer-pins), are $1\frac{3}{4}$ in. long, are flattened on both sides at one end, and have the other end rounded. A small hole for the string to pass through is drilled at a distance of $\frac{1}{2}$ in. from the top. The hitch-pins are made of wire about $\frac{3}{32}$ in. in diameter, and are 1 in. long. When these are in their places and the tops filed level, the harp is ready for stringing.

To string up, procure twelve violin first strings, rather stout, *and all of the same size* (this is important). Tie a knot at one end of each string and draw it up quite tight; then tie a second knot close to the first, and slip the noose thus formed on to No. 1 hitch-pin, and draw it up tight. The other end of the string is then passed through the hole in No. 1 wrest-pin, which, allowing about 3 in. of slack, is then turned to the right until the string is nearly tight. When all the strings are on, place the bridges under them, at a distance of 2 in. from the pegs at each end, and proceed to tune.

The tension of the strings should be low—or, in other words, they should be rather slack—as when the instrument is sounding the lowest or fundamental note is not heard. They must be tuned to the *most perfect unison* possible, or the beats caused by the difference of pitch would sound very disagreeable. Some prefer to tune them in fourths and fifths, but this is wrong, as the harmonics of these intervals will not agree with each other.

When required for use, place the instrument on the window-ledge, and bring the sash down close upon the wind-board, so that all the wind that enters the room must pass over the strings. If the draught is not sufficiently strong to start the strings into vibration, set the door ajar and the desired effect will be attained.

PRACTICAL PERSPECTIVE APPLIED TO THE DRAWING OF HOUSEHOLD FURNITURE.

BY WILLIAM CORBOULD.

I SHALL begin with the rules of perspective. After explaining them, we will draw a few objects by their use. I will be as concise as possible; but without a knowledge of perspective it would be impossible to draw anything correctly.

RULES OF PERSPECTIVE.

There are two rules of perspective—viz., parallel and angular or oblique—which constitute the point of sight, point of station, vanishing points, and points of measurement. Should the study be found dry, a little patience will soon simplify the matter. By working out the rules a few times, the student will find the subject easy enough, and will soon be able to work without them, or partially so.

First I will explain the horizontal line. This line gives the elevation (see Fig. 1). B B is the horizontal line; A the point of sight. Supposing the student to be standing on the sea-shore, looking out to sea, the line dividing the water from the sky would be the horizontal line, and the spot on that line straight before the vision would be the point of sight. You will say, But we are not drawing the sea or sky, but household furniture. Granted; but the

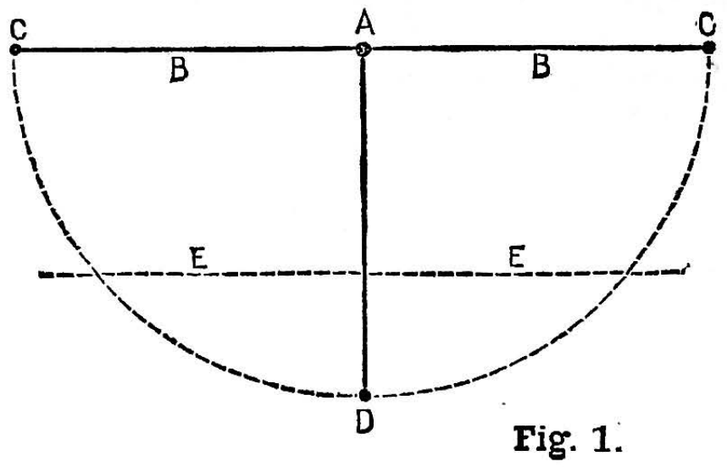

Fig. 1.

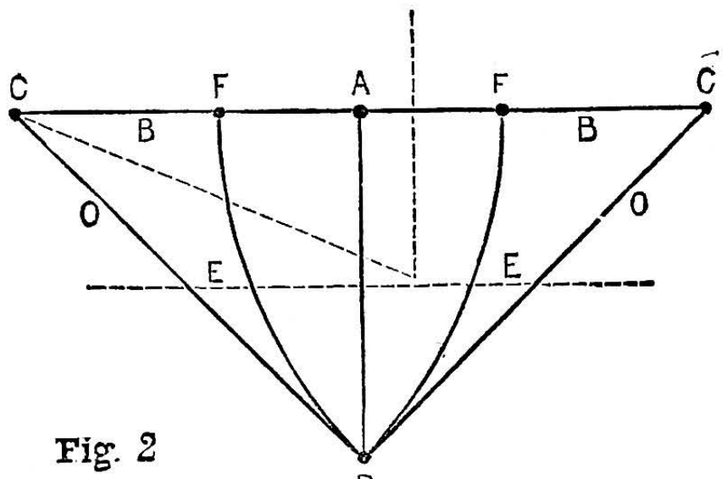

Fig. 2

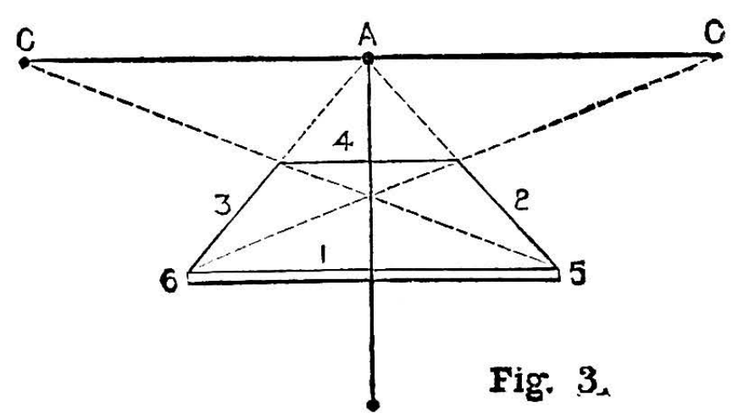

Fig. 3.

Fig. 1.—Points and Lines for working out a Drawing in Parallel Perspective. Fig. 2.—Whole of Points and Lines for Subject in Angular Perspective. Fig. 3.—Flat, Square Surface drawn in Angular Perspective.

rule is the same. In parallel perspective the point of sight is the vanishing point. When the spectator is standing directly opposite the object, one side, or the front of that object, immediately faces him, while all lines directly from him are falling into the point of sight, A, the spot the eye of the supposed spectator is looking at. If through this point you draw a straight line, parallel to the top and bottom lines of your drawing, this is called the horizontal line. All lines above it incline down towards it, and every receding line below will tend upwards to the same. The student must keep this in mind. C, C are the points of measurement; E E the base line. Now, on the elevation and depression of the point of sight depend the horizontal line, whether it is high or low; for if the point of sight is high, so will be the horizontal line, and if low in the drawing, this line will be the same. This rule is invariable. There are other points, but all lie in the horizontal line; to them all lines in angular perspective converge.

Our next rule refers to angular or oblique perspective. In A, Fig. 2, B B is the horizontal line, A the point of sight, C, C two vanishing points, D point of station—that is, where the person viewing the object would be supposed to be standing; E E is the base line. The lines O, O, drawn from C to D, determine the vanishing points, C, C. Now take your compasses, place their points on C and D, and strike a curve upwards. Where it comes in contact with the horizontal line the two points of measurement, F, F, are secured. Master these two rules thoroughly, and then we may commence to draw any object from them.

No better idea of perspective to the student could be obtained than to stand at the end of a long broad street, and take notice of the lines of the houses, street lamps, pavements, etc. He would see that they all come to one common centre. This would be the rule of parallel perspective.

For our first subject, let us take a square—such as the top of a table, a chair, sideboard, washstand, dressing-table, etc.—drawn in parallel perspective (see Fig. 3): 1, the front edge of the object; 2, a line drawn from the corner, 5, to vanishing point, A, which in this rule is the point of sight. This line will give one side, 2, and a line drawn from 6 to A will give the same for the other side of the object. The dotted line, 3, drawn from the corner, 6, to measurement point, C, also from 5 to the other point, C, where these two lines would cross line 4, would give the *back* side of the object.

For our next subject we will select a toilet-table drawn in parallel perspective. The student will see here (Fig. 4) that the point of sight is just above the centre of the toilet-glass; therefore, all lines fall into that spot, it being the point of sight, the person looking at the object standing direct in front. The first thing to do would be to draw your imaginary horizontal line, your point of sight being at the centre (see Fig. 1). Next draw your base line. Now set out your toilet-table on your base line—that is, determine the size you wish to draw the subject you are doing. The dotted lines in the figure will show the student the way to work, which I have no doubt, after a few trials, he will find easy enough.

We will now take a subject in angular perspective (Fig. 5; see rule, Fig. 2). In this case it will be seen that all lines fall into measuring point, C, which becomes the vanishing point, or point of sight. Supposing you wished to represent the same object from the other side, the perpendicular dotted line, showing the right-hand corner of object drawn, would be shifted to the left hand of the centre vanishing point, A. All lines would then fall into the right-hand measuring point, because it would become the vanishing point, the spectator having shifted his point of station from right to left of the object. (Compare Figs. 5 and 6.)

For our second object in angular perspective I have chosen a bedstead (Fig. 6): which being long, forms a good subject to illustrate this rule. It is drawn the reverse of Fig. 5, all the lines here falling into the right-hand measuring point, which becomes the vanishing point. This is simple enough. Having mastered this rule, you would go to work in this way:—Place a dot for the two front feet of the bedstead on the base line, then draw the right side of the object, continuing this line according to the elevation. At the end of this line make a dot: this will be your

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vanishing point. All the other lines will fall into this dot. Any other piece of furniture may be drawn the same way. The elevation is ruled by the vanishing point being high or low from the base line—that is, if you wish to show the top of the object, the vanishing point would be high on the horizontal line; but, on the other hand, if only the front or side of the object is to be seen, the vanishing point would be lower down. The bottom lines of the object would rise upwards to the vanishing point, while the top lines would fall to the same.

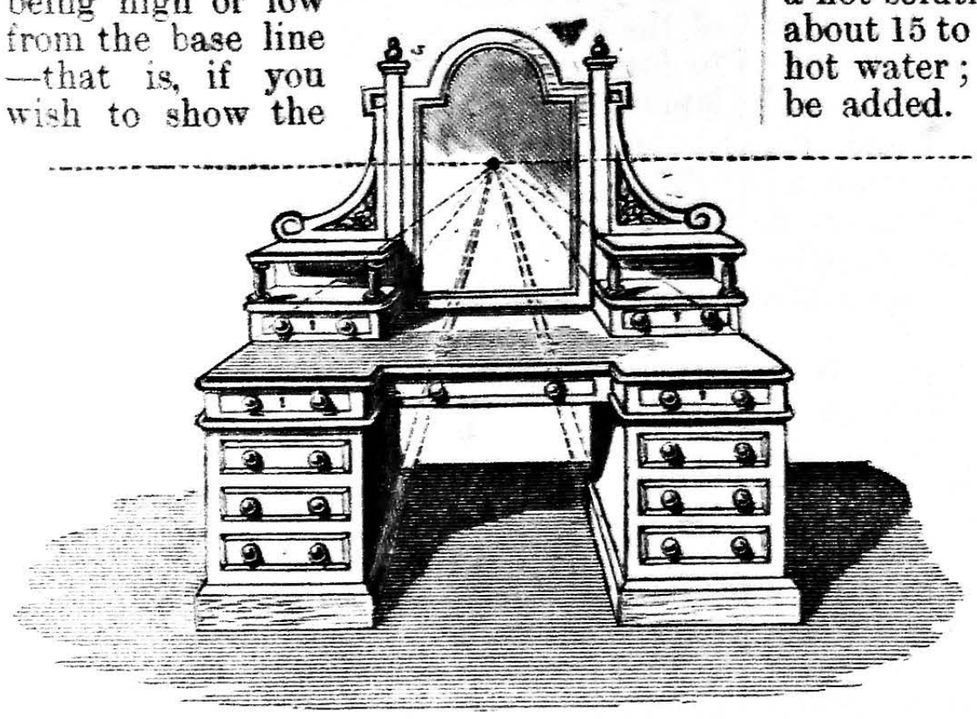

Fig. 4.—Toilet Table drawn in Parallel Perspective.

Our next object is a chair drawn in angular perspective (Fig. 7). This is drawn by the same rule as the bedstead; in fact, if space here permitted I might go on drawing any article of furniture for illustrating examples. I think I have done sufficient for the purpose. If the student will study the rules here laid down carefully, he will soon attain proficiency.

I will now close this article with one more diagram (Fig. 8): for drawing a circle in freehand—for instance, a table-top or any other circular object—by using the rule of parallel perspective, the dotted lines, as here shown, falling into the point of sight. You may now strike a circle in perspective freehand. You may not succeed the first or second time, but practice will make perfect.

PHOTOGRAPHIC EXPERIMENTS.

CURIOUS, AMUSING, AND INSTRUCTIVE.

BY WALTER E. WOODBURY.

PHOTOGRAPHS ON VARIOUS FABRICS—MOONLIGHT EFFECTS—TO RESTORE FADED NEGATIVES—TO MAKE GOLD CHLORIDE—HEADLESS PORTRAITS—TO PREVENT HALATION—HAND-MADE SLIDES—A SIMPLE HYGROMETER.

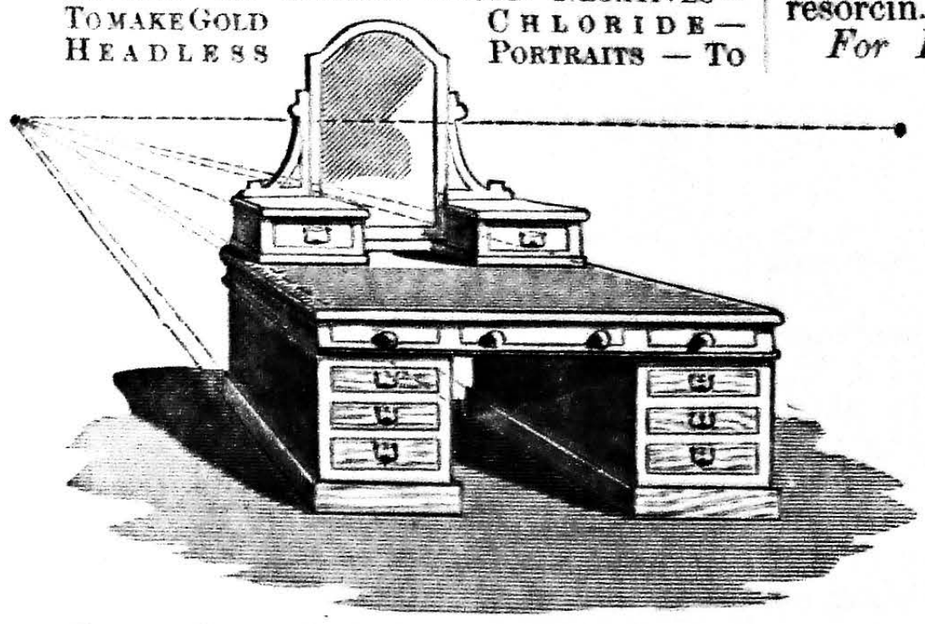

Fig. 5.—Toilet Table drawn in Angular Perspective.

Photographs on Various Fabrics.—By means of a recently discovered process, known as the "primuline process," very pretty images in various coloured dyes can be made upon silks, satins, cotton goods, etc. All the chemicals can be obtained from Messrs. W. Watson & Sons, or other photographic appliance makers. The material is first dyed in a hot solution of primuline, made by adding about 15 to 30 grains of the dye to a gallon of hot water; a little common salt should also be added. On immersing the fabric, and stirring it about in the solution, it becomes of a primrose-yellow colour, when it is removed and washed under a cold-water tap. The next process is to diazotise it by immersion for half a minute or so in a cold solution of sodium nitrate, ¼ per cent., which has been sharply acidified with hydrochloric or other acid. The material is again washed in cold water, but it must be kept in a weak light. It can be hung up to dry in the dark, or exposed while wet beneath the object of which it is required to produce a positive reproduction. This process gives a positive from a positive, so that any ordinary picture on a sufficiently translucent material—flowers, ferns, etc.—can be reproduced. Printing requires about half a minute in the direct sunlight to half an hour or more in dull weather, or if the material to be printed through is not very transparent. The high light becomes of a pale yellow, so that a faint image is perceptible; but this is made visible in almost any colour by development in a weak solution (about ½ per cent.) of a suitable phenol or amine. The following have been found suitable:—

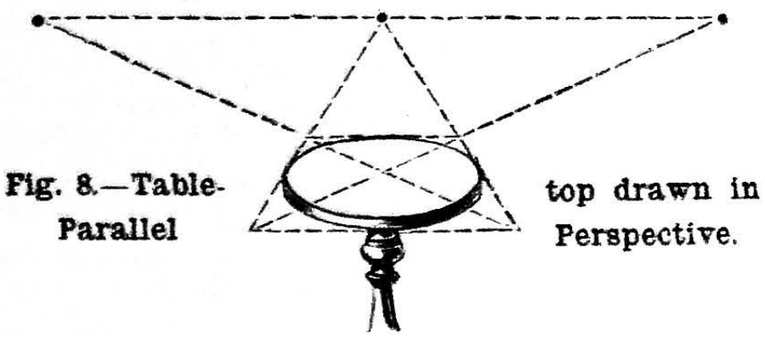

Fig. 8.—Table-top drawn in Parallel Perspective.

For Red.—An alkaline solution of β napthol.

For Maroon.—An alkaline solution of β napthol-disulphonic acid.

For Yellow.—An alkaline solution of phenol.

For Orange.—An alkaline solution of resorcin.

For Brown.—A slightly alkaline solution of pyro-gallol, or a solution of phenylene-diamine-hydrochloride.

For Purple.—A solution of α napthylamine hydrochloride.

For Blue—A slightly acid solution of amido, β napthol, β sulphonate of sodium, now better known as "eikonogen."

If the design is to be made in several colours, this can be done by painting on the different developers, suitably thickened with starch. After developing, the material is well washed and dried. With the purple and blue developers it is necessary to wash the material finally in a weak solution of tartaric acid. Wool and silk require a longer exposure to light than other fabrics, and cannot be successfully developed with the maroon or blue developer.

Moonlight Effects.—Curious as it sounds, very good moonlight effects can be procured on a bright sunshiny day. A photograph is made of a landscape in dazzling sunlight, a small stop and rapid exposure being given. The plate should, if possible, be backed with any of the substances recommended to prevent halation. Choose a landscape, with the reflection of the sun's rays in water, and include this and the sun itself on the plate. It is best to wait, however, until the sun just disappears behind a cloud. Shade the lens so that the rays do not shine on it direct, and expose rapidly. Use an old or weak developer. The sun and its reflection will, of course, make their appearance first. Continue the development until the detail in the under-exposed parts is just visible, and fix. Print very darkly, and slightly over tone. If printing is done upon green albumenised paper, and a little re-touching done with Chinese white, the effect is very good.

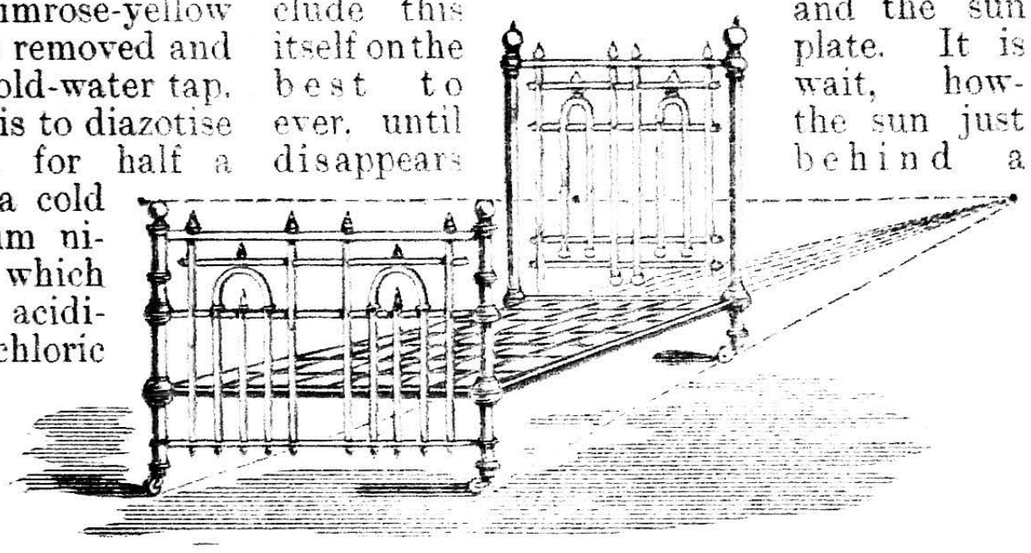

Fig. 6.—Bedstead drawn in Angular Perspective.

To restore Faded Negatives.—Negatives that have been intensified will often fade through some unexplained cause. They can be restored, however, in the following solution:—Schlippe's salt, 10 grains; water, 1 oz. Wet the film by soaking in cold water, and then immerse in the above restoring solution until the desired effect is obtained.

To make Gold Chloride.—Mix in a suitable vessel two fluid drachms of nitric acid and 1 oz. of hydrochloric acid. Into this place a sovereign or other gold coin—the newer the better—and apply a gentle heat. For this purpose a sand- or water-bath is preferable. A considerable quantity of gas will be evolved, and the gold will slowly disappear. If it does not do so entirely, a little more of the acids, mixed in the same proportion, should be added. The solution of perchloride of gold in excess of acid thus obtained is next evaporated in a sand- or water-bath, and the crystals formed are preserved in hermetically sealed bottles, as they are very deliquescent. This trouble of crystallisation can be saved if it is necessary to use the gold chloride in solution, and this is usually the case in photographic operations. It can be kept quite well if preserved in the dark. To the solution add 5 oz. of distilled water, and sufficient carbonate of soda to neutralise the

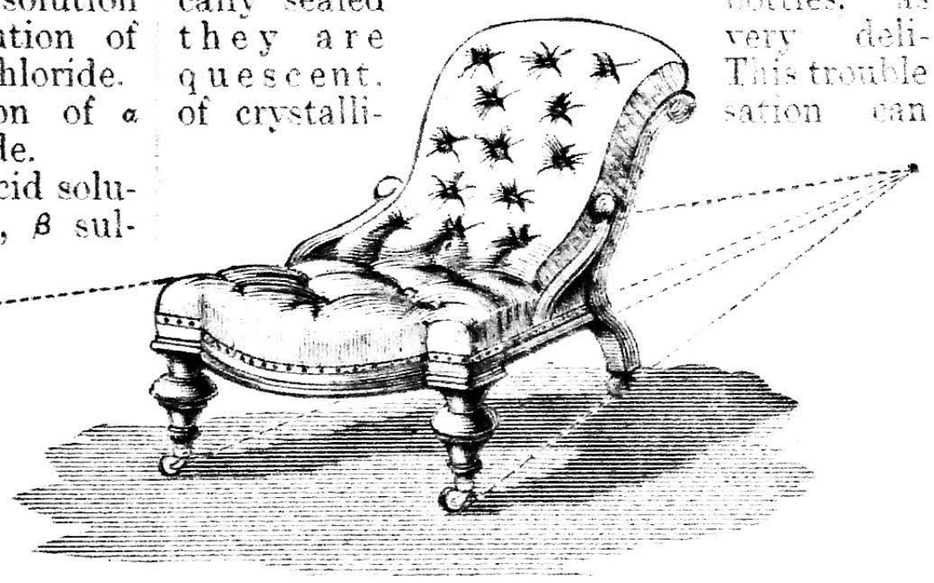

Fig. 7.—Easy Chair drawn in Angular Perspective.

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acid. Filter and add water, to make 174 drachms. This solution will contain, as near as possible, 1 grain of terchloride of gold to the drachm of water, as a sovereign contains 113 grains of pure gold, which should yield 174 grains of gold chloride.

Headless Portraits.—The portrait of a man holding his head in his hand, or carrying it on a tray or at the end of a spear, has always startling effect, and serves well to relieve the monotony of the usual portrait album of individuals in the conventional attitudes. Their method of manufacture is very simple. A white background is required. In front of this the subject is fixed, with his hand stretched out or holding the tray or spear to receive the head. The expression on the face should be a suitable one, and the eyes turned upwards or closed. A little care is required in printing, as here the desired effect is obtained. First block out the head with black varnish, put on the back of the negative. A headless man is thus printed on the sensitive paper. Then remove the varnish and block out the body in the same manner, leaving only the head printable. This is then arranged on the outstretched hand, tray, or spear, and printed again, care being taken to cover up all the other parts. Prints thus obtained are then toned, fixed, washed, and mounted in the usual manner, and are very useful for the purpose already stated.

To prevent Halation.—Mention has several times been made in these experiments of the necessity of preventing halation. It will be well, therefore, to explain the meaning of this term, and its prevention. Halation, then, is the term given to the halo which often surrounds the photographs of windows or trees with bright light shining through the branches. It blocks up all the detail, all objects surrounding being either in a mist or entirely obliterated. It is caused by reflection from the back of the plate, and can be prevented by coating the back of the plate with a mixture of powdered burnt sienna ½ oz., gum arabic ½ oz., glycerine 1 oz., water 5 oz. This can be readily washed off previous to development. Another method is to squeegee a piece of carbon tissue or American cloth soaked in glycerine to the back.

Hand-made Slides.—Those who work with an optical lantern will find the following a method of making slides upon which sketches or diagrams can be made for illustrating lectures, etc.: Glass of the usual lantern-slide size is coated with matt varnish of ether 50 parts, sandarach 1 part, mastic 1 part, benzine 10 parts. This gives a surface upon which drawings can be made, but not sufficiently transparent for the purpose. This can be done, however, by flowing it over with ether 100 parts, sandarach 3 parts, mastic 3 parts. This gives, when dry, a perfectly smooth and transparent surface.

A Simple Hygrometer.—An experiment showing the extreme sensitiveness of gelatine or gelatinous preparations. The method is the following:—Take a piece of board and fix in it another piece of wood, upright. Cut a slit in the side of this, and insert a strip of carbon tissue or gelatine-coated paper of any description. The effect of moisture will be to cause the strip to hang in a limp manner, but when the air is dry it will curl upwards. If a disk of cardboard is fitted behind it, and a scale constructed, a simple but perfect hygrometer is formed.

More of these experiments shall follow. Meanwhile, any difficulty that may arise can always be set right in the columns of "Shop."

HAND-WORKING OF SPECULA FOR THE NEWTONIAN TELESCOPE.

BY EDWARD A. FRANCIS.

From Sphere to Parabola*: An Elementary Lesson in Practical Optics.

In so far as the speculum worker is concerned, all the celestial bodies are infinitely distant from the earth, and all light rays, however they may diverge at the beginning of their journey, are parallel to each other by the time they reach the telescope.

A truly polished speculum receives these parallel light rays and reflects them so as to form a quite perfect image of the object (see Fig. 18). This image is called the focal image, and is examined by being magnified by the eyepiece. (See Fig. 2, page 50.)

A speculum polished to any other than the proper curve will form not *one* distinct image at one point, but a *series* of superimposed images, and consequently indistinct. The proper curve is parabolic.

By the surface of a speculum is meant the concave surface on which the silver film is deposited. Reflection takes place not *through* the glass, as in an ordinary mirror, but directly from the silver which is chemically deposited on the surface of the glass.

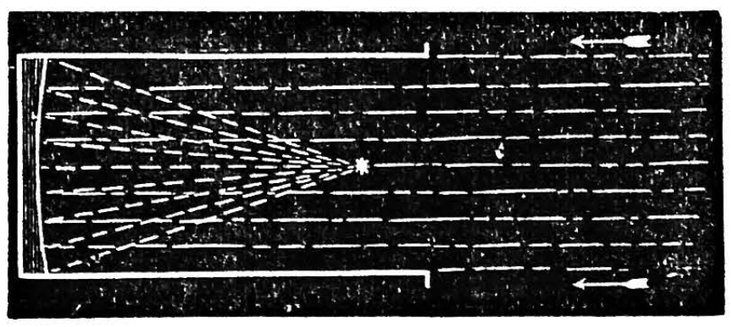

Fig. 17.—Reflection of Parallel Light Rays to one Point by a Perfect Speculum.

By the curve of a speculum is meant that curve exhibited by the concave surface in diametrical section.

A *spheric* mirror is a mirror any diametrical section of which is part of a given circle.

An *elliptic* mirror is a mirror any diametrical section of which is part of a given ellipse.

A *parabolic* mirror is a mirror any diametrical section of which is part of a given parabola.

What relation these three curves hold towards each other we shall now examine.

By means of Fig. 18 it may be traced how parallel light rays, falling directly on to a spherical mirror, are reflected.†

Let A B be the mirror, having its centre of curvature at C. Let D and E be two parallel rays of light from a star. Falling directly on the mirror, they will be reflected so that the angle of incidence will be equal to the angle of reflection. Join F C. Then D F C is the angle of incidence, and C F G being made equal to D F C, the line F G will show the direction in which the ray, D F, will be reflected, forming at G, with other similar rays, an image of the star.

This method of determining the line of reflection holds good for any ray falling on any part of the surface, and if, carefully increasing the angles, the ray, E, be similarly treated, it will be found to form an image at H.*

And so it might be shown that each zone of the surface, A B, would reflect rays so as to form a separate image, the series overlapping confusedly—that is to say, *a spheric*

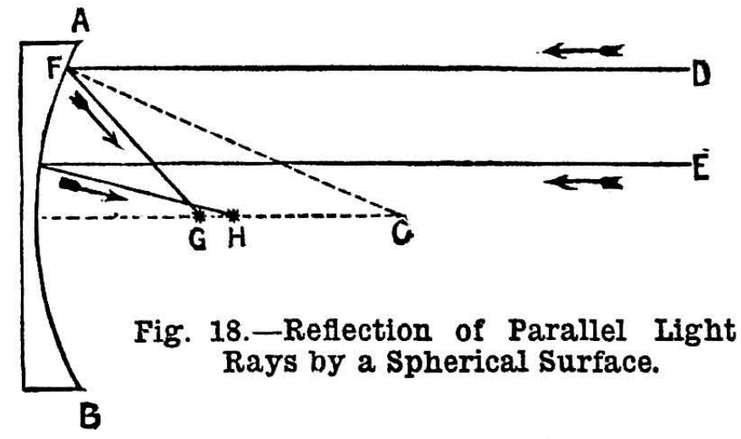

Fig. 18.—Reflection of Parallel Light Rays by a Spherical Surface.

mirror will not reflect all incident parallel rays to one point.

This irregular reflection is called spherical aberration, and it is the business of the speculum maker to correct it by altering the curve of his mirror, which he either deepens slightly, so as to bring the image, H, back to G, or flattens so as to throw G forward to H. The curve given to the mirror in either case is parabolic.

The spheric mirror will, however, under a certain condition, reflect light rays, not parallel to each other, to one point. Thus diverging light rays from a luminous object at C (Fig. 18) would be accurately reflected back to C, and (in Fig. 19) the rays from D, a luminous object quite close to the centre of curvature, C, are reflected unerringly (in effect) to the point E, where a perfect image is formed.

But if D, the source of light, be moved distant from the mirror, A B, spherical aberration will at once set in. Let D be removed to a considerable distance, as in Fig. 20; then, in order that the rays from D may be properly reflected, the curve A B, formerly spherical, will need to be made elliptical—part of the ellipse, A B C—and this will be done by deepening the concavity.

It is the peculiar property of an elliptic reflecting surface that rays diverging from the distant focus are accurately reflected to the near focus, and *vice versâ*.

A star, as has been said, is practically at an infinite distance from the telescope,

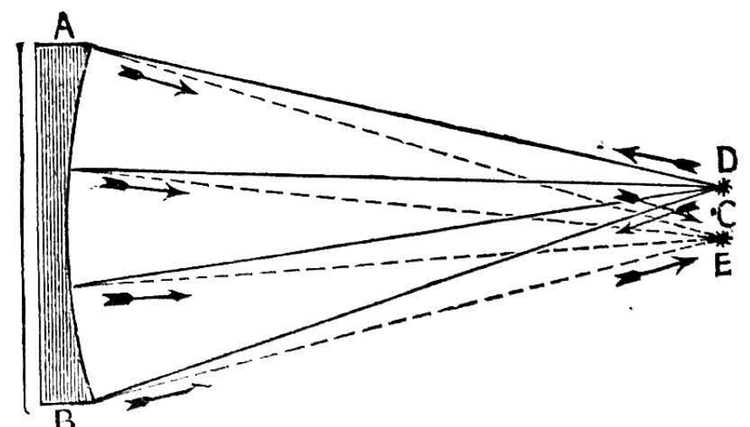

Fig. 19.—Reflection of Light Rays by a Spherical Mirror when the Source of Light is close by the Centre of Curvature.

and, to write colloquially, an ellipse with one focus infinitely distant from the other is a parabola, the parabolic curve being merely a curve more elliptic than an ellipse; so that, to make a spherical mirror perfect for the reflection of rays from an object infinitely

* Properly "from spheroid to paraboloid." These notes are written purposely in colloquial language, and readers who may be students will perceive the intentional departure from exactness in phrase and definition.

† It will be well for readers who intend subsequently to work by these notes to get compasses and paper and construct this diagram for themselves line by line.

* The same law (the angle of incidence is equal to the angle of reflection) applies to rays falling on a flat surface, but the angle of incidence is then found by erecting a perpendicular at the point where the incident ray cuts the reflecting surface. Indeed, in Fig. 18, joining the centre of curvature, C, and the point of contact, F, is equivalent to erecting at F a perpendicular to a tangent to the curve A B.

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distant, it is only necessary to carefully deepen the curve from sphere to ellipse and from ellipse to parabola.* An illustration of this is given by one method of working.

The mirror is first polished spherical, so as to accurately reflect some object at the centre of curvature (Fig. 19). The object is then removed to a short distance (Fig. 20), and the curve of the glass deepened (or flattened) until the reflected image is again perfect. The object is then still farther removed, and the curve again modified to meet the altered circumstances. Thus an approximation to the parabolic curve is obtained, and a little careful work in the same direction perfects the mirror for celestial objects.

To summarise: A spherical mirror can be parabolised either by flattening the curve from centre to edge, so as to lengthen the rays reflected from the edge and cause G and H (Fig. 18) to coincide; or (and this is the better plan) by deepening the curve from edge to centre, so as to shorten the centre

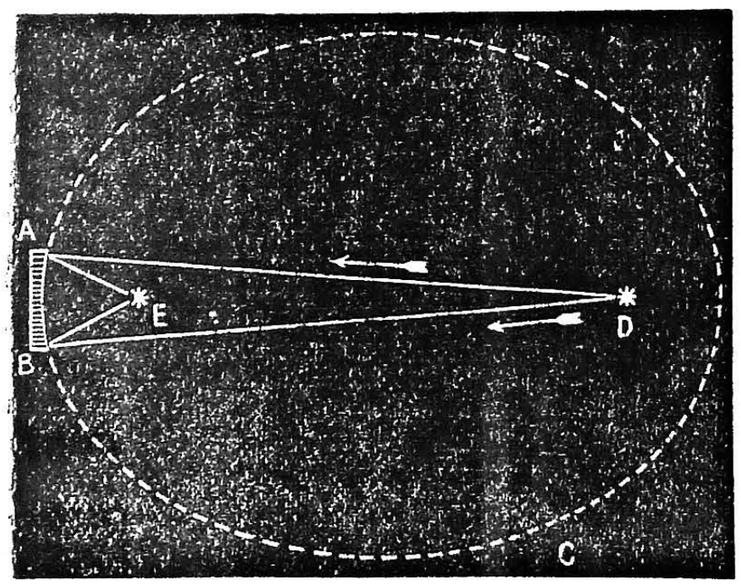

Fig. 20.—Rays proceeding from one Focus of an Ellipse reflected to the other Focus.

rays and throw H back to G. It is essential, however, that the flattening or deepening shall proceed regularly by infinitesimal gradation.

In an ordinary spherical mirror of long focus the distance, caused by spherical aberration, between the images, G and H, would be less than $\frac{1}{50}$ in., and half an hour's work with a polisher in good condition would cut away sufficient glass to deepen or flatten the curve to the parabola. The delicacy of the process will be apparent.

Perhaps the main difficulty is the securing of that exquisitely polished spherical concavity which is the necessary basis for successful figuring. Hence the need for most careful and conscientious work in the early stages of the grinding and polishing.

EVEN workers—or some of them—do not like wrinkles on the face. Here is Ovid's recipe for removing such:—Take equal parts of bean and barley meal, and mix with raw egg. When the mass is thoroughly hard and dry, it should be ground to a fine powder, and made into an ointment with melted tallow and honey. A thick layer of this applied to the face every night is said to smooth out all wrinkles, and make the skin as soft as a baby's. If this information is of no value to our male readers, they can at least pass it on to wives, daughters, or sweethearts.

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* Or to flatten the curve to the ellipse and parabola, so as to throw up the image G to H (Fig. 18). But I treat the plan of deepening only in theory, for simplicity's sake. In practice, also, it is simpler to deepen a curve regularly than to flatten it regularly.

SCIENCE TO DATE.

New Desiccator.—In the desiccator at present in use in chemical laboratories the substance to be dried is usually placed *over* the drying material—sulphuric acid, calcium chloride, etc. Now, since moist air is lighter than dry air, this arrangement is objectionable. Hempel has described a new piece of apparatus, in which the drying agent is placed at the top, and he proves, by experiment, that with this arrangement the drying is done three times more quickly than before.

Meteorology of 1891.—The rainfall for the year 1891 at Greenwich was 25 in., or ½ in. above the average; the number of hours of bright sunshine, 1,222, or about 66 hours below the average of the last fourteen years. The mean temperature was 48·4°, or 1·1° below the average. The highest air temperature in the shade was 85·1°, on July 17th, and the lowest 12°, on January 10th. The mean monthly temperature was below the average in every month except June, September, October, and December. The greatest wind pressure was 31·5 lb. on the square foot, on November 11th.

Nitrogen Flames.—When a high pressure electric discharge is taking place in air long, writhing, ribbon-like flames are formed between the terminals. Professor Crookes has recently called attention to the fact that they are true flames—namely, the nitrogen of the air combining with the oxygen and forming nitric acid. Luckily, the temperature of ignition is much higher than the temperature of combustion, and hence the flame quickly dies out, else the whole of the air might be at once consumed.

Copper in Fruit and Vegetables.—The United States Department of Agriculture have been carrying on investigations on the use of compounds of copper as insecticides and fungicides, with the object of ascertaining if copper is contained to an injurious extent in fruit and vegetables. From their report it appears that, under normal conditions of growth, grapes may contain as much as 2 parts in 1,000,000 of copper. Apples, plums, and other fruit which have been sprayed with Paris green contained about this amount of copper. Analysis shows that wheat may contain 4 to 10 milligrams of copper per kilogram, or an average of 7 parts in 1,000,000. It is curious to note that the 54,887,707 bushels of wheat exported by the United States to Europe in 1890 would contain 23,495 lb. of copper.

Effects of Lightning.—A curious phenomenon occurred at Vienna during a severe thunderstorm. In a large bullding fitted with the electric light all the Swan lamps were momentarily lit up, the lightning apparently being attracted by the electric wires. No damage was done.

WORKERS' QUESTIONS: THE HOUSING OF WORKMEN.

BY ECONOMICUS.

IN all our large industrial centres the problem of how to find healthy house accommodation is a pressing one. Workshops and places of business naturally cluster round railway depôts, and besides forcing rents up to an impossible point for mere dwelling purposes, render the active parts of towns unsuitable, from sanitary and other points of view, for wholesome family life. Busy streets, in which no tree or shrub appears, are not desirable playgrounds for children. The roar of heavy and continual traffic is not a pleasant accompaniment to ailments, and an atmosphere vitiated from a thousand different sources is not the kind of atmosphere in which any country is likely to succeed in rearing sturdy men and women.

Thoughts like these are present to the mind of every earnest man and woman, especially of hard-working parents who, utterly helpless themselves, see their offspring growing up sickly and puny. It is for this reason that the vigorous action of the Housing Committee of the London County Council in bringing pressure to bear upon the railway companies to extend facilities for the spreading of the working population over outlying districts is so heartily welcomed. It is, of course, in London that all movements of this kind begin, for it is in London that defective points in our civilisation naturally first appear and reach their highest point of development. Other towns, however, have quite as much of the housing difficulty already as to show that new lines of policy will have to be adopted to cope with it, and there is no doubt that, as in London, so it will be in the provinces—the railway companies, who hold the key of the situation, will be approached.

This being so, the important question for each individual workman is: How can he assist in promoting this movement? The only way is, of course, for him to combine with his fellows on an intelligent basis, to raise the matter at his club and at meetings of his society, and to insist upon candidates for local boards taking it up. Employers, as well as employees, are interested in the proper housing of the masses, for he who sleeps and passes his leisure in the fresh air will be a far more efficient workman than he who passes from the bench to the fœtid atmosphere of crowded courts and alleys.

We have said that the way to proceed is for workmen and, if possible, employers to combine on an intelligent basis, and for such combinations to bring pressure to bear upon local authorities and, through them, upon the railway companies to so reduce their fares that people of scanty means may be able to live a few miles from the smoke and dust of the city. Now, what do we mean by an intelligent basis? First of all, the workman must be convinced that what he is asking the railway companies to do is within his right. For instance, it would not be within the right of any body of men to demand that the tailors of this country should reduce the price of clothes by one-half or one-fourth, or to any extent. Why should the railway companies be subject to interference that tailors, butchers, shoemakers, and so forth are exempt from?

There is one big difference easily to see between such traders as tailors, etc., and railway companies. If a man does not like the prices charged by one tailor he can easily go to another. This cannot be done in the case of railway travel. Though there are thirteen railway companies with termini in London, for instance, no workman has the choice of using any one of these thirteen railways, but is practically confined to the railway whose terminus is nearest his shop and whose route is towards his home. Another peculiarity in railways is the fact that the different companies are formed into a combination whereby fares are kept up. Before a railway can reduce its charges it must get the consent of other companies. If tailors, shoemakers, etc., had the same power of keeping up prices as railway companies; if, in other words, they enjoyed the same monopoly as the companies, and the monopoly began to be exercised, or was thought to be exercised, to the detriment of the community, then the public would have a right to interfere in their businesses, as they are now doing in railway businesses.

There is an additional reason for expecting the railway companies to relieve our congested towns, and that is because the congestion is due to the railways. No big towns, it is safe to say, such as we are familiar with to-day would have sprung up but for the railways. Indeed, the size of our towns is in proportion to the railway service supplied them. Moreover, the bigger the town the more business does it yield to railways in carrying food, coal, manufactured and unmanufactured articles, out of and into such big towns. Arguments like these—and they might be put more forcibly—show that upon the railway companies the public have a special claim in the matter of this housing question, and that it is not an undue interference with private businesses to force the companies to reduce their fares.

Now, to what extent might they be reduced? This depends upon the size of the town. Where the population is large, and trains at low fares can be filled, the reductions that might profitably be made in fares are enormous. We have already instanced in WORK the twenty-two miles' journey between Liverpool Street and Enfield for 2d., which returns a handsome profit to the Great Eastern Railway. Sir J. Blundell Maple, too, has now managed to get the Metropolitan Railway to run workmen's trains at fares of ten miles 2d., twenty miles 4d., and thirty miles 6d. This rate will also rule on the Sheffield line that is coming to London. In London, where low fares can attract an unlimited number of passengers, it is thus proved by the Enfield workmen's trains that eleven miles for 1d. is not too low a rate to expect; and the Chairman of the Great Eastern Railway says that this rate pays the company if they get five hundred passengers to a train. These facts are worth the pondering, and suggest a basis of operation to bodies of workmen anxious to improve the conditions under which they live. They are worth the consideration, too, of temperance reformers, for the dull, leaden lives of those who perforce are driven into the holes and corners of our cities are a fruitful source of the misery entailed by excessive use of stimulants.

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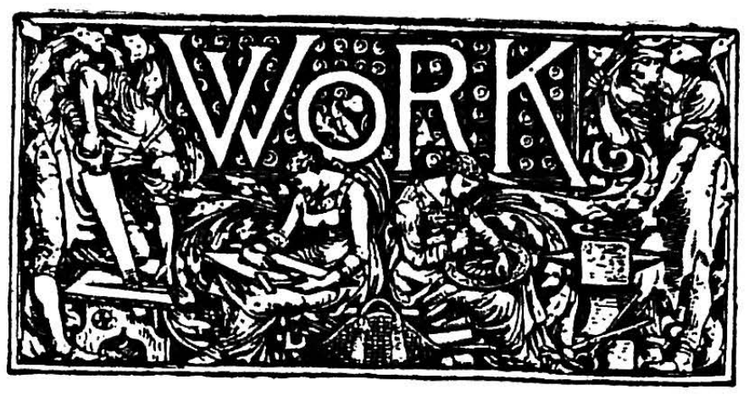

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WORKMEN'S INDIVIDUALITY.—In giving recent evidence before the Labour Commission, Captain Noble expressed an opinion that there is much less individuality among workmen now than was the case thirty years ago; that the present tendency is towards a dead level of uniformity; and that this is due to Trades Unionism. We are strongly of opinion that individuality to-day is not so marked as then, and that the tendency now, as compared with thirty years ago, is in the direction of a dull level of uniformity. But we differ as to the causes of this tendency. We hold that but for the unions matters would have been much worse than they are in this respect. It is, on the contrary, in the minute and ever-increasing specialisation and subdivision of labour that we see the cause of the dull uniformity which all thinking men deplore. Specialisation has killed individuality, monotony has strangled mental activity, repetitive tasks have destroyed interest, and the iron discipline of the big factories has reduced all to military precision and routine. There is scarcely a trade remaining in which the increase in the use of machinery and the subdivision of labour have left much scope for the exercise of individuality, or in which any freedom of initiative worth mentioning is left to the "hands." Not the least departure from set methods can be made by those hands. In any change whatsoever, the initiative can only be taken by principals, managers, or foremen. This, mainly, is at the bottom of the torpidity of the present race of workpeople. Unionism, therefore, has nothing at all to do with it. Men, for the most part, would take delight and interest in their work if they had a free hand, and sufficient variety and scope to occupy their faculties. The old craftsmen were all-round men; the new hands are men of one section, one fractional part of a craft. Carlyle's famous verdict of the population of these islands, "comprising some thirty millions, mostly fools," is, perhaps, not to be gainsaid. But the grand old cynic might have allowed "extenuating circumstances" in the case of a large proportion of that population. Knowing what we do of factory life, the marvel to us is that our operatives have developed so high a degree of intelligence in the midst of conditions which are extremely adverse to intellectual culture, and to the development of inventive genius. It is a positive fact that there are hundreds of thousands of working people whose duties are restricted to one most minute operation, or series of operations, and who, under the discipline and stress of the factory system, are so incessantly occupied all day long therein, that they are absolutely prohibited from giving attention to anything beside. A hundred, a thousand other operations may be going on around them, in other workrooms and departments, under the same roof, week by week, year by year; yet of these they remain in completest ignorance. "All the little piece of intelligence there is left in a man is not enough to make a pin or a nail, but exhausts itself in making the point of a pin or the head of a nail." Of course, we know that these conditions are permanent. We cannot go back to the old domestic system of manufacture. It developed individually, but was too wasteful for present-day requirements. Our aim must be to retain the advantages of subdivision of labour without suffering loss of intellect. The only corrective possible lies *in the development of a broader culture* among our working people. There is the remedy embodied in a single sentence. This would include all aids of an intellectual character, all means for the development of literary, technical, scientific, and inventive genius. By means of these individuality will be saved from atrophy or extinction, dull, daily duties will be rendered more endurable, whatever of faculty there is in a man will be drawn out, labour in many cases will become more remunerative, and so tend to bring about the ideal of a shorter day; and lives now dull and leaden will become transfigured with brightness, and feel the interests and attractions of a new and higher life.

MUSEUM LECTURES.—Numbers of people can be seen wandering aimlessly and listlessly about our museums. Is there any need for this? Where are the peoples' teachers? We ask seriously if free lectures or demonstrations cannot be given during the winter evenings. We know that the gentlemen who have charge of the different collections are proud of them, and anxious to have them appreciated by the public. Will they, or some of their juniors, take up the matter of free lectures and demonstrations? There are no great difficulties in the way. No serious expense is needed. Notwithstanding the excellent "Art Handbooks," we know that much more pleasure and instruction will be given by a few lectures than by reading about this or that class of artistic or scientific object. We trust that all who are responsible for our museums will give this suggestion a trial. At present not half the use is made of these national treasure-houses that might be were some such simple scheme as that indicated carried into effect. Surely it will not be impossible to find men able and willing to give clear and popular lectures on the treasures of our museums during the coming winter evenings. In this way thousands of workmen could be intelligently educated. Something after the plan of the Rev. Dr. Kinns' lectures in another direction is wanted.

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HELICAL GEARS.

BY J. H.

Helical Bevel-wheels.

The Relations and Dimensions of Bevel-wheels—The Toothed Block—Marking Out—Working to Outline—Method of Withdrawal.

The figures in this article illustrate the making of a helical bevel-wheel moulding block. It is necessary, however, before describing the bevel tooth-block, to explain the primary relations and dimensions of a pair of bevel-wheels.

The Relations and Dimensions of Bevel-wheels. — In Fig. 9, A represents a bevel-wheel, B the pinion gearing into it, C, *c* are the major and minor pitch diameters respectively of A, and D, *d* the corresponding pitch diameters of B. The primitive cones of the two wheels, upon whose ideal surfaces rolling occurs, meet at E, and the tooth-points and roots converge, like the pitch surfaces, to that apex, E. In ordinary bevel gears the tooth-flanks and faces converge also to that centre; but this is not the case in helical gears, because the teeth form portions of helices, winding upon the surfaces of the primitive cone (as illustrated in Fig. 3, p. 219). Nevertheless, the terminations of the teeth on their outer faces and their apices touch radial lines, as shown at *e*, *e* (Fig. 9).

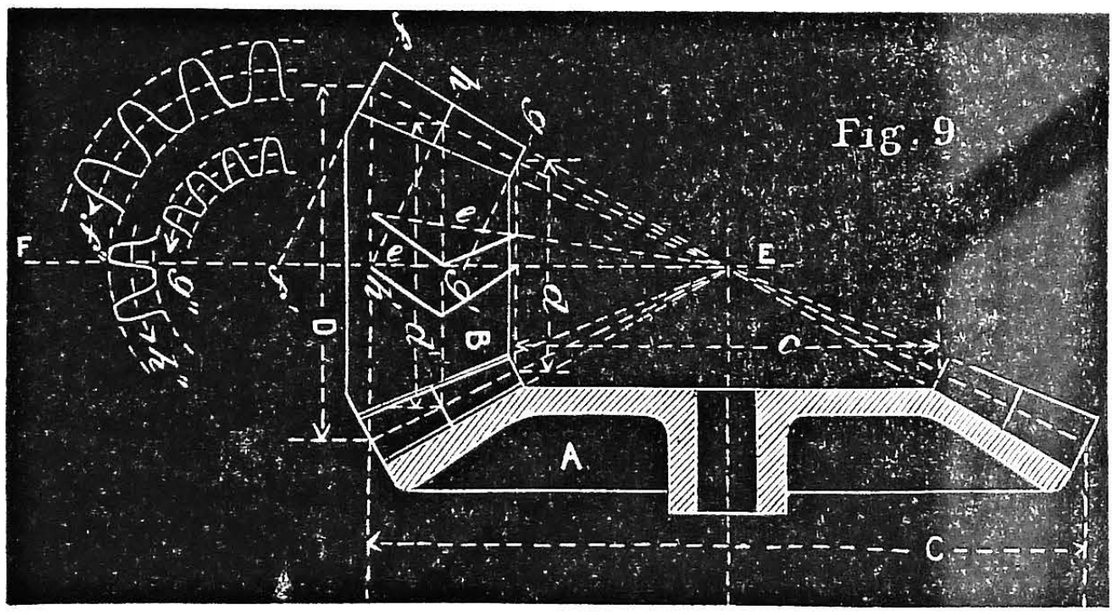

Fig. 9.—Diagram to illustrate the Elements of Bevel Helical Gears.

The forms of the teeth are struck precisely like those of ordinary bevel gears. Lines *f*, *g*, *h*, representing respectively the major and minor terminal planes and the middle plane of the teeth, are projected until they cut the centre line, F E, of the pinion B. Then the radii, *f f'*, *g g'*, *h h'*, are taken and struck in any convenient position, as at *f''*, *g''*, *h''*, below, and represent the projected pitch-lines upon which the shapes of the teeth for the terminal and the middle planes of the pinion are to be struck. The lines drawn concentric with these represent the root and point-lines.

The Toothed Block.—A toothed moulding-block for a bevel-wheel is, in respect of section and curvature of faces, exactly as though a segment were cut out of a complete wheel pattern. In the tooth-block the shape of the back and top face is, of course, exceptional, because these portions are always made by means of cores, with which we are not concerned in this paper. Always the top and back of a tooth-block form a rectangle to receive the carrier, N, in Fig. 10, of the wheel-moulding machine. The way in which a toothed block for a bevel-wheel is marked out, in order that its section shall be the same as that of its wheel, is as follows:—

Fig. 10 shows the tooth-block complete; Fig. 11 shows it in an early stage. By comparing the two and noting the dotted lines, it is seen that there are certain dimensions corresponding with certain definite portions of the wheel rim, of which one set are *concentric*, the other *parallel*. The total thickness, A, of the tooth-block, and its total width, B, are not of much importance, but the relative positions of the cardinal lines are of great importance.

Marking Out.—First, then, a block, B (Fig. 11), from 6 in. to 10 in. long, dependent on the fineness or coarseness of the pitch, and suitably divided, and dovetailed to its backing, is prepared, of a width and depth fairly proportioned to the section of the wheel, and of a convenient size for the carrier of the machine. It is squared carefully to the dimensions, in order that lines may be marked accurately upon the faces, and a centre line, A, squared over on all four faces. Then, with suitable radius, corresponding with the radius C, in Fig. 10, the outer line, C, in Fig. 11, is struck on one face, and the line F concentric with it, and the line D on the other face corresponding with similar lines on Fig. 10. The bevelled sweep, G, is then worked down with chisel and plane. This face, G, now represents the root-face of the wheel, to which the teeth are attached. The gauged line, E, corresponding with the line E in Fig. 10, is run round on the sweeped face, G, and the short bevelled sweeped face, H, worked round from E to F, and this face is then continuous with the ends of the teeth on the major diameter of the wheel and the top face of the rim; and the body of the block representing the bottom of the teeth is now ready for the teeth.

At this stage a solid block is fitted around the sweep of the block B, in Fig. 11, for the teeth to be worked from, as in the spur-wheel (Fig. 6, p. 279). The large end of this block is bevelled off continuously with the bevelled face, H, just worked on the piece B, and the small end of the block is struck and worked to its bevel by lines I and K (Fig. 10). Upon the ends of this block, then, the pitch circles, D and *d*, in Fig. 9, are struck with respective radii, the bar of the trammel being held parallel with the faces of the tooth-block. The pitch circles *f'*, *h''*, in Fig. 9, and the striking lines (not shown in the figure), and the circle of the tooth-points, all struck also with normal radii, are marked with trammels. As the centre of these circles lies away from the block itself in all except the smallest pinions, the block is screwed in the vice, or else clamped to the end of a board or bench, and the centre line, A, of the block projected along to the centre of the wheel. While thus set, all the lines for one side are struck, and afterwards, the block being turned over and the centre found, the lines on the opposite side.

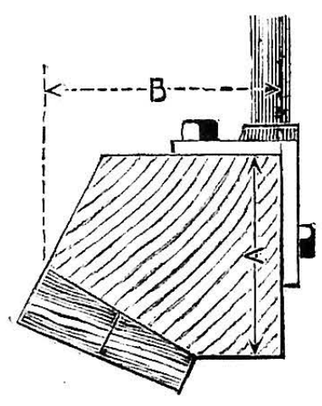

Fig. 12

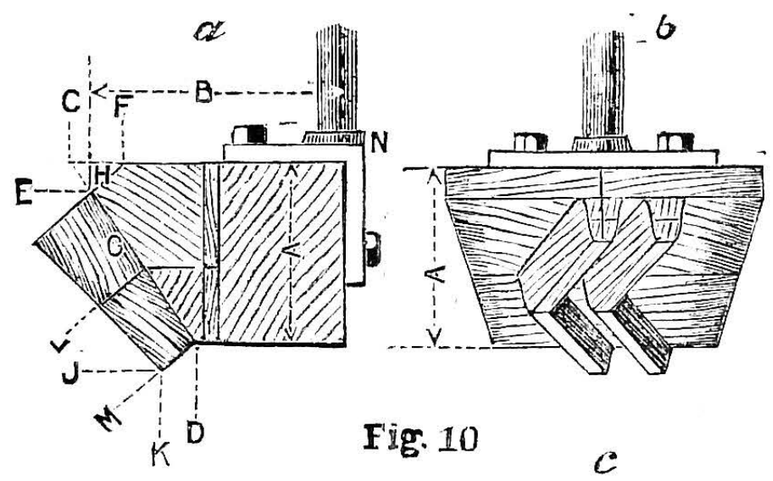

Fig. 10

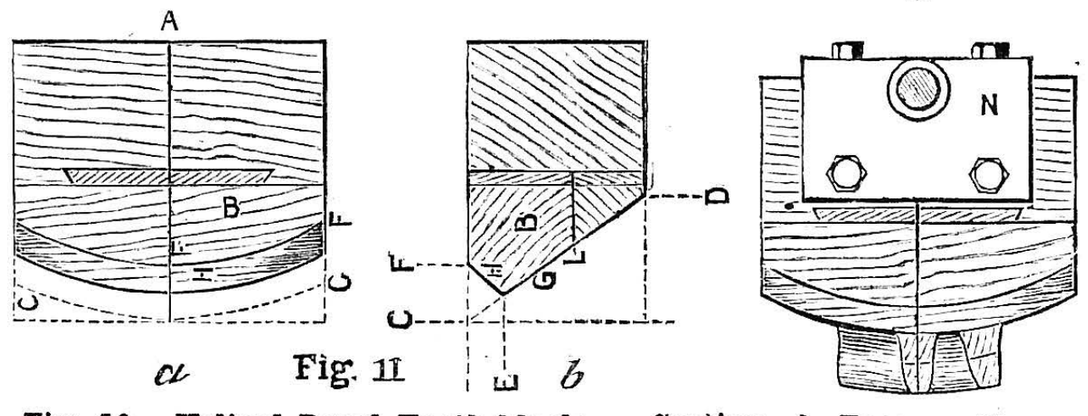

Fig. 11

Fig. 10.—Helical Bevel Tooth-block—*a*, Section; *b*, Face; *c*, Plan. Fig. 11.—Block in course of Preparation for the Teeth—*a*, Plan; *b*, Section. Fig. 12.—Section through the Block for a Crown Bevel.

Working to Outlines.—The dovetailed blocks, B, with their attached tooth-blocks thus marked, are then removed from the backing-piece, and the pitch- and striking-lines and tooth outlines marked on one of the joint faces, L. The sweeped face of the tooth-points is worked now, and the screw-lines are then marked upon the curved face with bent steel, and the teeth worked through from the outer to the middle face.

The size of the teeth and the radii of their curves on the middle plane are a mean between those of the outside faces. To assist accurate working, templets should be made to the inter-tooth spaces, midway between the centre and the outer faces. For the accuracy of the sections intermediate between these the trained eye may be trusted.

Method of Withdrawal.—It is even more desirable and convenient that the teeth be divided along the line L in this example than in that of the spur-wheel given in the previous article. To ram the lower half of the teeth while the upper half stands over in the way is awkward (see the face view of Fig. 10). Still, it is not actually necessary except in small pinions. But it *is* essential that the block B, that carries the teeth, be made distinct from the backing; for except in those machines where provision is made for withdrawing the block in a diagonal direction—that is, in the line M—the entire block could neither be drawn horizontally, because of the sand behind H, nor vertically, because of the diagonal setting of the teeth on the block.

But there are some bevelled tooth-blocks that can be lifted vertically—that for the wheel A, in Fig. 9, for example. This block is shown in section in Fig. 12, and it is clear that, in consequence of the extreme flatness of its bevel, the teeth can be lifted vertically, and therefore be made fast to their backing-piece, which could not possibly be the case in Fig. 10, as is apparent from the front view.

In my next paper I will speak about wheels made in cores, and then I hope I shall have said enough upon the construction of helical wheel teeth. If not, there is "Shop."

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IRON BRIDGE MODELLING IN CARDBOARD.

BY FRANCIS CAMPIN, C.E.

METHOD OF CONSTRUCTING UPRIGHTS—FLOORING—CROSS-GIRDERS—RAIL-BEARERS—ERECTION OF BRIDGE—SLEEPERS AND RAILS.

THE uprights, E, are made by first preparing for each the 3 in. by 3 in. angle-irons shown in section at A, Fig. 5 (see page 293). The actual distance between the insides of the side plates is then to be measured, and the pairs of angle-irons secured at this distance from outside to outside glued to double thicknesses (C) of card, as shown at B. The calculated width of the upright is 1 ft. 9 in.; the height of plates at top and bottom is 1 ft. But it is well to make these rather slack in width, for they can be packed out with a layer or two of note-paper, but, if too wide, cannot be put in place without bulging the side plates of the main members, and would therefore have to be thrown aside, and new ones made. The lattice-bars connecting the angle-irons should be placed as nearly at right angles to each other as the space between the plates, C, allow, opposite corners of which, D, D′, are to be cut away for half their thickness to make room for the extremities of the end lattice-bars. This cutting away should be done before the two thicknesses are glued together, as there is then a clean surface left for the connection of the lattice-bar ends. At other points between the angle-irons the lattice-bars cross, the double thickness of card at each end holding them at the right distance apart for this purpose. Here the bars are glued, as also where they cross each other, and on each side of each such joint a rivet-head is to be fixed. These uprights will extend from the top to the bottom flange-plates, and their lengths must be measured off the general diagram. In putting in the uprights, it will be found most convenient to start from the centre of the span, as they must be inclined to be brought between the side plates. The uprights on each side of the centre may all be placed at first between the side plates in inclined positions near the ends, and they can then be brought successively into their permanent positions, the insides of the arches and ties being first touched with glue at those places at which the uprights are to be fixed. After all this work is set, the 6 in. counter-brace bars between the uprights may be glued at the ends and sprung into place. There are four in each bay, two being fastened on the inside of each side plate. They are not connected at the centres, where they cross.

The open ends at A and C are to be covered by plates 2 ft. 6 in. wide, connected to the side plates by angle-irons 4 in. by 4 in. by $\frac{1}{2}$ in. thick. At each end plates 2 ft. 6 in. wide and 4 ft. long are to be attached as bearing plates. These, in the bridge, would be about 2 in. thick, and should therefore, in the model, be made up with three or four thicknesses of cardboard. Similar plates are to be made to place upon the supports at each end. At one end the bearing plate will rest directly upon the bed plate; at the other twelve rollers will be interposed, which would be about 3 in. in diameter, with a clearance of $\frac{1}{2}$ in. between them. These, in the model, would be represented by wooden rollers $1\frac{1}{4}$ in. long by $\frac{1}{8}$ in. in diameter, kept in position by end-pins in their centres. These pins will pass through holes in the side bars of a square frame which surrounds the rollers. With a slight clearance, the distance apart of the pins will be $\frac{7}{44}$ in. These centres are easily set out by marking off the distance between the end rollers, $1\frac{5}{8}$ in., and dividing it into eleven parts. The end bars of the frame should be $\frac{1}{8}$ in. clear of the end roller centres. The supports may be of card, plaster, or wood, to imitate masonry work.

Next we have to deal with the flooring, and may conveniently commence by making the buckled plates, which will be required for carrying the ballast and any incidental load that may come upon it. These plates will rest upon the longitudinal bearers on the angle-irons, A; their sides by the cross-girders will be supported by angle-irons, A′, and those against the main tie will rest on angle-irons, D (Figs. 8, 7, and 6; page 293). These angle-irons are 3 in. by 3 in. by $\frac{1}{2}$ in. thick. Where the buckled plate fillets meet each other they will be connected by a cover consisting of a 6 in. by 3 in. by $\frac{3}{8}$ in. T-iron, riveted on underneath. Two rows of buckled plates will be placed between each pair of cross girders; therefore, in the direction of the length of the bridge they will each measure 3 ft. $11\frac{1}{2}$ in., allowing for the thickness of the cross-girder webs and a slight clearance for getting into place. Across the bridge there will be three different widths of buckled plates: in the six-foot, between the tracks, they will be 5 ft. $11\frac{1}{2}$ in.; between the rails of each track, 4 ft. $11\frac{1}{2}$ in.; and between the outer rails and main ties they will be 4 ft. $9\frac{3}{4}$ in. All these are outside measurements over the fillets, which should be 3 in. wide. The plates are to have 3 in. rise in the centre, and will be modelled in the manner previously explained.

The rail-bearers (Fig. 8), to fit exactly between the vertical limbs of the cross-girders, should be 7 ft. $10\frac{5}{8}$ in. in length, but it will be safer to cut them a trifle bare, to allow for fitting. The web being cut, the vertical limbs of the angle-irons may be cut the full 3 in. wide, and glued on to coincide with the edges, top and bottom. The angle-irons, A—to carry buckled plates—should then be made separately, and, when quite set, glued on to the web with the full-width strip of card horizontal and $4\frac{1}{8}$ in. below the top of the finished bearer. This cannot be well scaled off, so the guiding lines may be put $3\frac{1}{2}$ in. below the edge of the web. The bottom flange and angle-irons will run the whole length of the bearer, but the top flange must terminate $5\frac{1}{2}$ in. short of the end, and the horizontal limbs of the top angle-irons $2\frac{1}{2}$ in. short, to allow the vertical limbs to run in under the cross-girder angle-irons, the $\frac{1}{2}$ in. plate of the bearer butting against the side of that of the cross-girder. Angle-iron brackets, B, are glued to the ends of the bearers, with packing underneath, where necessary, to connect them with the cross-girders. They should be so joined up that the angle-irons, A, on the bearers are on the same level as the angle-irons, A′, on the cross-girders.

The cross-girder (Fig. 7) has two flange-plates at the centre and one cover-plate. The outside plates at the top and bottom are $\frac{3}{8}$ in. thick and 20 ft. long. The inner plates are in two lengths, and meet in the centre. The joints are covered by plates outside the $\frac{3}{8}$ in. plates. The covers are 12 in. wide and 4 ft. 8 in. long. They are placed in the centres of the cross-girders, which have an outside depth of 2 ft. at the centre, and taper to $11\frac{1}{2}$ in. at the ends, where they rest upon the main angle-irons of the main tie, D (Fig. 3), and are secured by angle-brackets on each side to the side plates of the main tie exactly opposite the uprights, E (Fig. 3). Above the vertical limb of the main angle-iron a piece of card is fixed as packing, to make a flush surface for the cross-girder end to bear against. The exact length of the cross-girders is 25 ft. 7 in., as they run $3\frac{1}{2}$ in. on to each main tie. The general mode of construction is the same as already described. Between the spaces occupied by the ends of the rail-bearers (Fig. 8), angle-irons, A′, are fixed to support the buckled plates, and between these, and at the same level, similar angle-irons, D (Fig. 6), are fixed on the inner side plates of the main ties.

The point is now reached when the whole work is to be put together. The four cross-bearers for each bay are to be connected by the central and two side rows of buckled plates, the greatest care being taken that the work is absolutely square and parallel, and the bearers at their correct distances apart. To ensure this, the bearers may be secured to a marked board by drawing-pins, the heads of which clip down their bottom flanges when they have been properly adjusted to the marks. The pins must not pierce the flanges. The buckled plates may then be fitted, their edges being pared down, if necessary. When the buckled plates are glued on, the work is left thus secured until it has thoroughly set. Some modellers prefer to leave out a few of the floor plates, in order that the work beneath may be seen without having to look underneath the model. The rivet-heads on the bearers and cross-girders will all be $1\frac{1}{2}$ in. in diameter and 4 in. pitch, except at the ends, where they must be worked in as near that pitch as they will come. On the buckled plate fillets a rivet-centre should be marked at each corner in the centre of the fillet, and the sides divided up to as near the pitch of 4 in. as it will come, and, whatever it is, the bearing angle-irons must be marked to correspond. It must be remembered, in setting out the rivets in parts connected by angle-irons, that the rivets in the angle-irons are always zig-zagged, so as to avoid making two rivet-holes in one section of the bar. This arrangement is shown in Fig. 9 (see page 293). It will be observed that the rivet centres in the top plates fall between those in the side plates.

When the bearers and central part of the flooring have been made up—with the T-irons under the buckle-plates where they meet—they must be connected with the cross-girders. In this case it will be most convenient to lay the work upside down, as the cross-girders are flat on the top, but tapered underneath. The positions of the cross-girders having been exactly marked on the table or board on which the bridge floor is to be put together, one end cross-girder should be secured by drawing-pins, as described above, the intermediate bearers and flooring glued and applied to it, and the next cross-girder immediately applied and secured to the board. This process is continued until the flooring is completed in length, and it is then left to set.

This is not, of course, the actual way in which the iron bridge itself would be put together in any case, but is the most convenient way to erect the model structure, in which glue or cement takes the place of rivets.

Where surfaces to be glued meet, rivet-heads must be left off. In actual practice the rivets would pass through all the plates superposed. When the floor work has set, its sides must be gauged by a straight-edge to ascertain that all the cross-girder ends are in line, and by a square to show that they are vertical. If not true, they must

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be trimmed with a knife or the glass-paper file. The flooring is now to be turned the right way up, and the ends of the cross-girders glued, and then the main arches and ties, blocked up to the height required by the tapers in the cross-girders, applied to them, and held until the glue adheres. The arches should be fitted with notched distance-rods, to keep their upper flanges at the proper distance apart while the glue or cement sets. It is very convenient in this final process to have a board fixed at right angles along one side of that on which the joining of the floor to the arches is made, so as to secure absolute verticality of the arches. The outer rows of buckled plates can be slipped into position after the rest of the work has set. Longitudinal sleepers in wood, with model bridge rails in card, may be fixed over the lines of bearers C; or transverse sleepers, with card representations of ordinary rails, may be laid on a bed of sand spread over the floor, to suit the modeller's fancy. The end cross-girders will be connected with the supporting surfaces by buckled plates, carried by angle-irons on the cross-girders at one end and resting freely on the supports at the other.

PROCESS FOR ENAMELLING SILVER PRINTS.

BY DR. LEO BACKLAND

THIS process gives a better finish to the prints and renders them waterproof. Such enamelled prints can be easier mounted than by the usual methods, and when being mounted the gloss is not decreased by the application of paste. Clean glass plates are rubbed in with talcum as for the usual process, and then afterwards the plates are collodionised with collodion containing 1 per cent. gun-cotton. When the layer of collodion is perfectly dry, the plate is coated a second time with a solution of rubber in benzole. This solution is easily made by dissolving 1 oz. of unvulcanised Para rubber in 100 oz. of benzole, and straining through muslin after complete dissolution of the rubber. When the indiarubber coating is dry the so prepared plate is ready for receiving the print. If the print is on albumen paper, it is soaked in a warm 10 per cent. solution of good gelatine, after which it is applied with its surface on the prepared plate, softly squeegeed upon it, and then allowed to dry, and when dry it is stripped off in the usual way. Prints on aristotype paper can be enamelled with much less trouble by squeegeing them simply when wet on the glass plate coated with collodion and rubber, and slipping them off when dry.

FURNITURE REVIVER.—To make a good furniture reviver, pour half a pint of linseed oil, two ounces of distilled vinegar, half an ounce of muriatic acid, one ounce of spirits of wine, one and a half ounces of oil of almonds, a quarter of an ounce of muriate of antimony, three-quarters of an ounce of spirits of hartshorn—all to be mixed cold. To polish: Take a piece of *clean* rag, shake the mixture and pour a little upon the rag, and rub the furniture well, and finish off with a piece of *clean, soft* rag. N.B.—The mixture must be shaken each time the rag is replenished.

SOME GOOD THINGS.

Glass Frame Sash Silencer.—That there is another "Glass Frame Sash Silencer" in the market implies that one was wanted for carriages. The smooth roads and spring wheels in their quiet action show more plainly where any rattle exists in a carriage. Indiarubber wheels on the ends of metal blades let into the edge of the glass frame are the silencing media. The glass of a carriage works up and down grooves with fences to hold the glass in, at all degrees of elevation. Fig. 1 is a glass frame ready for fittings. Fig. 2

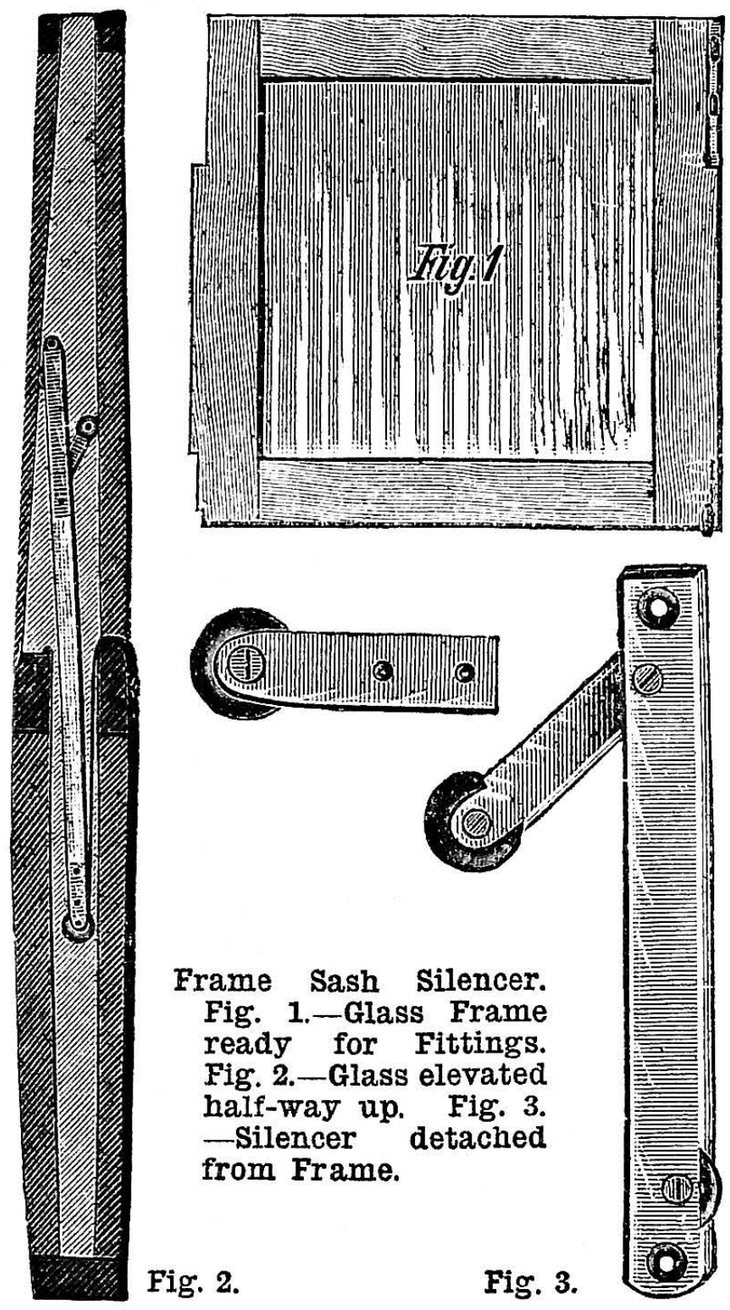

Fig. 2. Fig. 3.

Frame Sash Silencer. Fig. 1.—Glass Frame ready for Fittings. Fig. 2.—Glass elevated half-way up. Fig. 3. —Silencer detached from Frame.

shows a glass elevated half-way up; the silencer, acted on by a spring, is pressing the top edge of the glass frame against the fence; at the bottom it has a rubber wheel, acting also against the fence. Fig. 3 shows the silencers detached from the frame. There are four to each frame. The whole construction is simple, and its application to carriages will add to the comfort of riders, and enable them to converse without the accompaniment of a rattle. Messrs. Whittingham & Wilkins are the agents.

Forge and Bellows.—Fig. 1 is an illustration of a cycle brazier and ordinary forge combined, made and sold by Mr. Walter Careless. It is a speciality for those trades requiring a good and powerful brazing forge. It will be noticed that the bellows are worked by foot to leave both hands at liberty. An advantage is that it can be used for bottom heat at the same time that the blowpipe is in use, thus saving gas and time during the operation. There are no expensive taps to get out of order, as by inserting a plug in the back of the pipe it can be used as a smith's forge, or by plugging the front of the tuyere it can be used as a brazier without bottom heat. Fig. 2 represents Careless's Double Blast Gas-blowing Foot Bellows. These are compact and powerful for all small brazings and solderings wanted by brassfounders, silversmiths, coppersmiths, electro-platers, glass-blowers, dentists, etc. They are made with width of bellows, 10 in., 12 in., 14 in., and 16 in., at a charge respectively of 28s., 30s., 35s., and 40s. each nett.

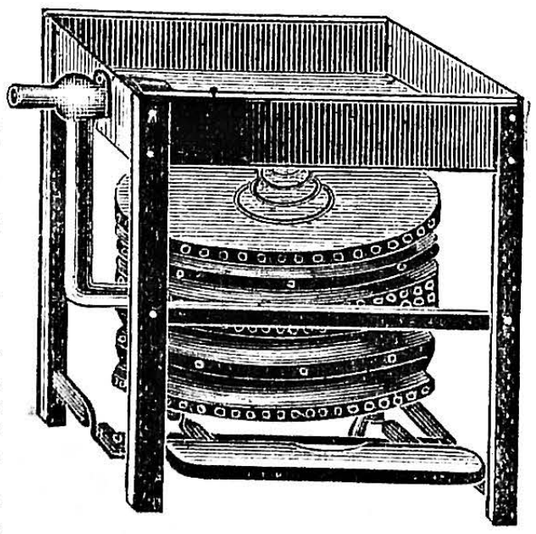

Fig. 1.—Combined Brazier and Forge.

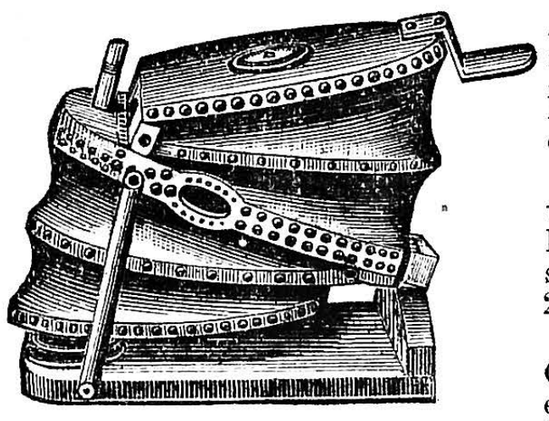

Fig. 2.—Foot Bellows.

NOTES FOR WORKERS.

MINES for copper ores, antimony, iron pyrites, and galena are worked in Newfoundland, but, owing to the absence of roads, the mining is confined to near the sea-coast. Zinc, molybdenite, manganese, chromite, nickel, hæmatite, gold, silver, etc., are all known to exist. Clay has lately been discovered near St. George's Bay, and building materials and clay are abundant.

THE total quantity of beer consumed in the United Kingdom during 1891 was 1,140,021,648 gallons, of spirits 39,164,762 gallons, and of wines 29,855,753 gallons. The total amount of intoxicants would, therefore, be 1,209,042,163 gallons, or just over 32½ gallons per head of the population.

IN April, 1893, a grand international naval review, in connection with the Chicago Exhibition, will be held in New York Harbour.

RAPE oil has no action on brass and tin, and of other metals it acts least on iron and most on copper.

ALUMINIUM is now used instead of gold-leaf for ornamentation, and, whilst being cheaper, is quite as neat. Two locomotives and tenders at Indianapolis, U.S.A., have been lettered with it.

IN future, Spanish war-vessels will be armed with Ordenez instead of Krupp guns. The gun factory at Trubia, in the province of Asturias, will soon be equal to supplying all required.

THE moon is 400 times nearer to the earth than the sun is, and hence appears to us to be as large as the sun, although, in reality, it would require 70,000,000 of bodies as large as the moon to equal the volume of the sun.

DURING 1891 the total export of Russian petroleum from the Baku district was 218,881,225 gallons, of which the British Empire took a third. During that time there were 238 wells at work, yielding about 125,000 barrels, of 42 gallons each, per day.

THE new "Greenwich" steam fire-engine added to the Salford Fire Brigade is capable of throwing 750 gallons per minute in one, two, four, six, or eight jets.

MR. EDISON is perfecting an instrument by which he says twenty-five men in a fort can destroy an assaulting enemy by means of an electric stream of water directed against them.

To dye silk black, it must be first washed free from grease, then gently boiled for half an hour in a dilute solution of iron nitrate, rinsed in cold water, and boiled for one hour with half its weight of logwood.

AS an instance of the spread of electric lighting, the municipality of Mandalay, Burmah, are considering an application to light several streets of that town with incandescent lamps.

IN hydraulic forging, a pressure of 3,000 to 4,000 lb. per square inch will deform hot steel, but at least 15,000 lb. is necessary to fill the corners of a mould, and 20,000 lb. if the corners are square.

THE new tent being introduced into the German army is divisible into two portions, each of which can be used as an overcoat by the soldiers in case of rain or cold.

A NEW submarine vessel, to be propelled by electricity, has been invented by Signor Pullini, of the Italian Navy, and one is now being constructed by the Italian Government at Spezia.

THERE is to be a tower 1,150 ft. high and containing 6,000 tons of steel at the Chicago Exhibition.

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TRADE: PRESENT AND FUTURE.

ROLLING MILLS.—Sheffield rolling mills and forges are only employed about four days a week.

CUTLERY TRADE.—The dispute at Messrs. Rodgers & Sons' continues. Trade is dull and depressed, few orders coming in from America and the Continent.

COTTON TRADE.—Over 80 per cent. of the Employers' Federation are in favour of a 5 per cent. reduction in wages, so that notices will be given to the operatives forthwith.

SILVER TRADE.—The plate trade is depressed, with no demand for cheap goods. The foreign request is for goods of best quality. The German scare has only proved how superior English silver manufactures are.

ENGINEERING TRADE.—The improvement in the engineering trade of Lancashire has not been maintained, and most branches are very short of work. Locomotive builders are quiet, and boiler makers have little new work coming forward. The returns for the month of the Amalgamated Society of Engineers show a considerable increase in out-of-work members, 6½ per cent. of the total membership now being in receipt of "out" support. So far as the Manchester district is concerned, it is considered that the number of members unemployed is now larger than for a very long time past. As regards the Steam Engine Makers' Society, there is little change, the returns still showing about 2½ per cent. "out"—the largest proportion of unemployed being found in the marine engineering centres.

FILE TRADE.—The depression in this and kindred branches continues, the workmen being reduced to three and four days per week.

BOOT AND SHOE TRADE.—In Liverpool the retail boot and shoe shops are only doing very little trade, and the leather market is unchanged.

GOLD THREAD TRADE.—The home trade is still very quiet. The latest advices from Bombay report trade very dull there on account of large stocks of old threads. A similar state of things exists at Madras. A small trade is being done in frosted threads, but other imitation gold and silver threads are not in demand.

COAL TRADE.—The South Wales coal trade seems to be approaching a crisis of no ordinary nature. For many years this great industry has been regulated, in the matter of colliers' wages, by a "sliding scale," this being regulated by the average prices realised by the colliery owners and brokers, and fixed by representative auditors at regular periods; but the colliers have determined to throw up the sliding scale basis of payment, and to join the Miners' Federation.

IRON TRADE.—A revival marks the Midland pig iron trade. The demand is for both foundry and forge iron, and prices are being advanced to keep off pressure by consumers. Best Derbyshire pigs were advanced to 47s. delivered; Northamptons, 45s. 6d.; and Lincolns, 50s. Foundry prices are 1s. 6d. per ton above these figures. The Lancashire iron trade shows little business. In Derbyshire a better tone prevails, and at the blast furnaces there is a good output, while the finished iron trade is steady. Our Liverpool correspondent writes:—The export of iron shows a decided decrease upon last year's quantities. In iron, etc., the following prices are ruling: Marked bars, £8 10s.; common Crown bars, £6 5s. to £6 7s. 6d.; hoops, £6 10s. to £6 12s. 6d.; black sheets (singles), £7 2s. 6d. to £7 5s., doubles, £7 10s. to £7 12s. 6d.; Alloway charcoals, 13s. 6d. to 14s.; Siemens' tins, 12s. 6d.; Bessemer tins, 12s. 6d.; B.V. cokes, 12s. 3d.; Dean ternes, 12s. There is very little inquiry either for black or tin sheets.

STEEL TRADE.—In Lancashire there is an improvement. In the Barrow district, however, several mills are temporarily idle, owing to trade disputes. At Sheffield the better class of crucible steels has received a slight impetus, but common brands cannot find a market.

SHIPBUILDING TRADE.—In Lancashire this is very bad. At Barrow business is very quiet, and at the present time it is, temporarily, almost at a standstill, owing to a strike of smiths, pattern-makers, engineers, etc., who are resisting a 5 per cent. reduction of wages. At Liverpool the trade has not recovered its tone at all, and it does not appear as though there would be any improvement this year. Our Aberdeen correspondent writes:—A slackness is beginning to be felt in some branches of the shipbuilding and marine engineering trades here. Pattern-makers have little to do, and moulders are gradually getting out of work.

JEWELLERY TRADE.—In London things appear on the move—slowly, it is true. Still, there is an undoubted increase in the orders.

BUILDING TRADE.—In Aberdeen trade is exceptionally busy, and fresh work comes steadily in. Master masons and granite workers refuse to grant the men the extra ½d. per hour. In the Liverpool district builders are still actively employed on small dwellings. Bricklayers have been wanted for Lancaster, 9d. per hour being offered. At Cardiff the strike, which is in its sixth month, continues—masons, plasterers, and plumbers being concerned. The points in dispute are rates of wages for mechanics and labourers and the question of subcontracting.

SHOP:

A CORNER FOR THOSE WHO WANT TO TALK IT.

I.—LETTERS FROM CORRESPONDENTS.

Technical Education for Soldiers and Sailors.—J. C. K. (*London, N.W.*) writes:—"The subject is a vast one, yet it can be put in the metaphorical nutshell. The military and naval system of bond service under perpetual supervision admits of the easy application of training men to the arts and crafts of useful things in every-day demand. The success of the partial application of technical training of soldiers and sailors is a full warrant for its general application to every man in the service; this, of course, includes officers. What is now done is briefly noted for reference. The cavalry regiments have so many farriers and armourers, who are highly efficient workmen. They have saddlers and harness-makers, clerks, tailors, shoemakers, cooks, etc., and these are generally coveted situations, as the drills are fewer and military duties less. The artillery are similarly favoured, with the addition of wheelwrights, carriage-makers, etc. The Engineers have many more arts and crafts to which their soldiers are trained, and the survey of Great Britain and Ireland, as well as much of our Colonial Empire, attests the highly intellectual training of the men, in which the officers participate and supervise. But this technical education only includes about 10 per cent. of the army numbers. Of the navy, about the same extent of technical training in arts and crafts prevails—of course, combined with engineering and seamanship. The Marines are less favoured by this training than any. What prevents its general adoption? Nothing but the inertness of those who have the power to say, 'Let it be done.' The question comes in at once, 'What prevents this order for technical training?' 1st. Incapability of officers, who should be teachers of the technology of crafts, to a great extent, as they are of drill, etc. 2nd. False pride at having to attend to common work that soils the hands. 3rd. The absence of suitable workshops in or near barracks. Reviewing these reasons *seriatim*, it will be asked if officers should be the teachers. With bonded men none others could be introduced to barracks, especially as the teaching would be primarily for the service requirements, for its material of transport, barrack building, including workshops, and all that is needed for the exigencies of war. Officers are the *élite* of the people for dash and energy, and could soon be efficient teachers. Now comes the insurmountable barrier—pride. Many of these gallant fellows, whose silly mothers—and fathers, too—would deem it *infra dig.* for their darlings to soil their hands at honest work, which really would give dignity to their existence as men, would exclaim, 'What! like a common working man?' 'Yes,' I would reply, 'even as exalted as that.' And I should like to have the power to add, 'The order must be obeyed.' This would imply school and college training. The want of workshops in barracks or on ships would at once be a prime starting action of technical education for the soldiers and sailors to build them. Here would be a dozen crafts, and some professions included—as the surveyor, draughtsman, designer, architect, quantities estimator, brickmaker, potter, iron-founder, smith, forester for felling timber, sawyer, waggon-builder, carpenter, joiner, plasterer, stonemason, bricklayer, ladder-maker, glazier, plumber, carver, gilder, painter, upholsterer, etc. etc. The diversity of work, even in extending barracks and dwellings for furtherance of workshop erection for technical training, would find out the capacity of every individual in a regiment or ship, and a superfluity of talent or lack of it might be regulated by exchange of men from other regiments or corps. In some cases the work would be extramural, so that quarry work, brick-making, forest work, or foundry work, would be done as convenient to the depôt of a regiment or its barracks as might be deemed serviceable. All this technical work has to be done when a regiment is on foreign duty in war time, though mostly done in a perfunctory and haphazard way. Bridges have to be built from timber cut down by soldiers, forts erected, huts raised, and much unexpected work has to be met by men who are not trained for it, often without adequate tools, shops, or appliances. So in time of peace thoroughly capable workmen might be turned out of the whole of the rank and file of army and navy. Soldiers and sailors now receive extra pay as artisans; this should be extended to all. Officers, whose pay, it is said, in the lower grades is barely enough to pay laundress and tailor, would be owners of a craft and earners of honest money. I fancy I hear some persons say, 'Fudge! It is easy enough to let your pen gallop away with your ideas, while you lash them with the whip of fancy. Has anything like it been done?' I have already shown what history has told us—it has been done in war-time. 'But in peace-time?' the objector will interrupt. Well, I will take a survey of what has been done in peace-time with farm labourers, free from the restrictions of military compulsion, and without adequate education. The writer took charge of a large property—a model farm and two others, 800 acres, also an estate of 1,500 acres. His first act was to raise pay and increase it for overtime, which is essential in some seasons of farming, forestry, brick-making, and pottery work. His next was to order all implements, carts, waggons, wheels, harness, cottages, and farm buildings, to be made or erected by the men without extraneous aid, except foundry work. Every man was engaged to go on or leave at an hour's notice, and each was to be paid as a mechanic or artisan, if he did that work. Being thoroughly experienced in all these crafts, he took the trouble to teach every man his branch of trade, and the farm work was carried on so efficiently that one year some of the men were able to earn a double harvest, as he could spare them for the in-gathering of a neighbouring farmer. The system was by a gradation of work according to the augmenting capability of each man. The hurdle-maker was made a gate-maker, and then a cart-maker, then a wheelwright and implement-maker. Others from the woods were made pale and lath renders, sawyers, and soon merged into carpenters' or implement-makers' work. The skins of the animals killed on the estate were sent to be tanned and curried, and harness- and collar-making was taught to the man with the pliant fingers. Smiths were made from men who liked forge work, brick-makers and bricklayers and plasterers were made with the aid of one who was not only one of the best farm labourers, but a first-rate bricklayer. Farms and cottages were built, roads made, bridges built, and the crops were augmented in bulk and quality. The stock of animals improved, and in all root crops 'on the ridge' a furrow crop was also obtained. Ensilage was made in large barns packed up to the tie-beams, long before the name was coined for what was then known as salted and packed chaff. Here was work economically done by the will of one man with what some people would have deemed incapable men, with no other constraint than the respect the men bore for one who they knew often worked twenty hours out of the twenty-four in devotion to a principle—that those under him should be as capable as himself in craft work, and be well paid for all they did. Sobriety was one of the main aids to success. The hour's notice to quit was the plain cause of such unfailing sobriety that no man ever had to leave at an hour's notice. Those who did leave went with the highest characters, and to places yielding better prospects in life. What a humble individual could do well on a farm the State could do better for the army and navy."

Quarter Horse-Power Engine.—F. A. M. (*Eastbourne*) writes:—"Replying to the question of G. W. S., on p. 318, I have sent to the Editor a design for a boiler for the quarter horse-power engine, which has been adopted by one of the makers, and have entered with it remarks and suggestions for its improvement. I should like to suggest here to our Editor that a suitable boiler for that engine would be a capital subject for a prize competition; and that it might be within the constructive powers of an amateur, it should be a pipe, or 'sectional' boiler, composed by screwing together steam-piping, the whole to be set in fire-brick in such a way that it might go into an ordinary fire-place when the fire-stove is removed. Thus the amateur would run no risk of an explosion."—[Thanks for the suggestion from an esteemed member of the staff, but our competitions necessarily have to be interesting to all, rather than to sections of, readers.—ED.]

II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Clock Spring.—F. L. L. (*Richmond Hill*).—You do not say what you require it for, or if you have any parts you want to utilise; if not, I should suggest you get one of those cheap American lever timepieces, take the works out of the case, and take away the balance and pallets; then take off the 'scape wheel from its arbor, and fit a fly or fan on the arbor in its place; keep the fan or fly as large as it can be to free the next wheel and arbor. By doing this you will save a lot of time and trouble, and it will be cheaper in the end. You might pick up an old movement complete from a watchmaker good enough for your purpose for next to nothing, or I may be able to find one for you if you will pay postage, as we frequently throw them away when they will not go.—A. B. C.

Barrow Making.—P. E. B. (*Birkenhead*).—Articles appeared in WORK, Nos. 68 and 174.

Cameras.—A. H. S. (*Kelvinside*).—Articles on the construction of cameras appeared in WORK, Nos. 13, 23, and 70.

Pedals to Piano.—A SUBSCRIBER FROM THE COMMENCEMENT.—A paper on this subject is in hand, and will shortly be published.—M. W.

Electric Early Riser.—ELECTRO NOVICE.—There have been many designs and descriptions of electric alarms in WORK. Consult back numbers and indexes of volumes, or purchase numbers 32, 131, 160, and 179.

Graphs.—A. W. (*Stockport*).—An article on "How to Make Graphs" appeared in WORK, No. 162.

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Electric Current Measurement.—J. B. (*Keighley*).—I have several times explained the meaning of terms used in the measurement of electric currents. When the measurements are given in ampères, they relate to the volume of current measured, the pressure being disregarded. When the measurements are given in volts, they merely indicate current pressure, or potential, the latter being the more correct term. When the measurements are given in watts, they indicate both potential and volume, one being multiplied by the other: as, for example, 50 volts multiplied by 10 amperes equal 500 watts. Read in another way, it might be put down as 10 ampères at 50 volts' pressure. This latter method is more definite than watts alone, as will be readily seen by comparing the following multiples:

10 volts 50 ampères = 500 watts.
20 ,, 25 ,, = 500 ,,
50 ,, 10 ,, = 500 ,,

You will find further information on this subject in Vol. III., p. 221.—G. E. B.

Engine Traction.—WOULD-BE DRIVER.—The only course we can advise our correspondent to take, under the circumstances he names, would be to get employment where such engines are made, or in those places where they are in use, so that he may, by helping, learn as much as he can about them—how they have to be handled, and the other conditions incident to their use; and if persevering, attentive to his duties, careful in his work, above all *sober*, and proves himself trustworthy and capable, he may, in a year or two, fit himself for what he desires. There are no special books that we know of which treat on such matters, but most of the makers publish and send out with such engines instructions for their use and management, but the books alone will not give the necessary ability for the purpose, this only being acquired by practical working and experience under the various conditions they have to encounter in working.—C. E.

Auto-Harp.—MUSIC.—The auto-harp, or chord zither, is an instrument that has only lately come into use, and I believe all the different arrangements for producing the chords are patented. For the rest it is identical in shape and size with the better class of Prince of Wales' harp, and may be made with from twelve to thirty strings.—R. F.

Musical Glasses.—D. B. (*Batley*).—In Vol. II., p. 325, of WORK is an article on the selection and arrangement of a set of musical glasses which you might peruse. To get them perfectly in tune they are partly filled with water, and the liquid used to dip the fingers in is only clean water slightly acidulated. The edges of the glasses must be scrupulously clean, as the slightest trace of grease will prevent the fingers "biting." A great deal depends upon "knack" in producing a good tone, but when this "knack" is once got the glasses respond immediately to the touch. They may also be played with a violin bow, or a small wand covered with leather and resined; but neither of the latter methods give the peculiar liquid tone obtained by "wiping" round the edge of the glass with the fingers.—R. F.

Arc Lamp for Dynamo.—J. W. T. (*No Address*). Had you given me the output of your dynamo in ampères and volts, I could have given you a more useful reply, as I could then have told you the kind of arc lamp suited to the current obtainable from your machine. Presuming that your machine will give an output of from 5 to 8 ampères at a pressure of 50 volts, I think you cannot do better than get one of Messrs. Woodhouse & Rawson's "Diamond" arc lamps, or one of Beaumont's "Equilibrium" arc lamps. The last will cost about two guineas, and may be obtained from Mr. Beaumont, Nunnery Lane, York. Mr. G. Bowron also makes a cheap arc lamp for amateurs. You will probably get even more light from an arc lamp than the figure you quote. Useful instructions and illustrations on making an arc lamp will take up more space than can now be spared in "Shop."—G. E. B.

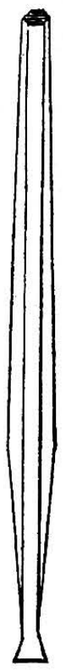
Bicycle Enamel.—G. T. (*Birmingham*) and A. W. (*Manchester*).—Proceed by scraping off all the old enamel or paint, then rub every part with emery-cloth or glass-paper; wipe with a rag that is free of oil or grease. Get club black hard-drying enamel, and float it on freely with a soft brush. As this enamel is somewhat thin, it will not be sufficiently covered with one coat. Rub down the first coat with fine emery-cloth, then float on another coat. If carefully done, the result will be fairly good, though not equal to stove enamelling. To have the machine properly enamelled, send it out to a professional enameller. Club black enamel is to be had from any cycle depôt. Guest's enamel is pretty much the same as club black; also of all cycle dealers.—A. S. P.

Bicycle Springs.—VIBRATOR.—Springs of almost every kind may be had of Geo. Salther, spring balance maker, Birmingham. The price, of course, depends upon the kind of springs wanted. Our correspondent's letter is indefinite on this point.—A. S. P.

Electro-Motor and Dynamo.—A. F. (*Ovenden*).—Until I clearly know what you and your friends mean by an electro-motor and dynamo combined, I cannot help you. Any small dynamo made to light one or two lamps may be used as a motor when furnished with suitable brushes, and currents sent through it from a strong battery such as a Bunsen or Grove.—G. E. B.

Embossing.—S. K. (*Leytonstone*).—To retain the acid on the glass whilst it is etching it, form an edging all round with either wax or putty, the height to be regulated according to the acid you pour on, and that will be determined by the depth you wish to etch the glass. If the acid has been acting on the glass for some time it will be hardly worth while retaining it, but as to that you must decide for yourself. Retain it and try it again, you will soon see whether it answers. For etching needles and gravers try Brodie & Middleton, Long Acre, and if they have not got them in stock, they could soon procure them for you.—W. E. D., Jr.

Monumental Work.—WOULD-BE SCULPTOR.—An article on this subject may appear in a future number. Have you read the article on "Masons' Work" in Vol. III. of WORK? The accompanying sketch represents a tool for cutting letters. The cutting edge is spread out, and they are made in various sizes from $\frac{1}{8}$ in. to $\frac{1}{2}$ in. wide. After the letters are marked, they are cut in with an ordinary chisel of suitable width, then cut with the lettering tool, using a lead mallet. The letters are blacked with the best black paint mixed with gold size; as much gold size must be added as will prevent the oil in the paint from running and discolouring the stone. The stone should be perfectly dry when the paint is applied.—M.

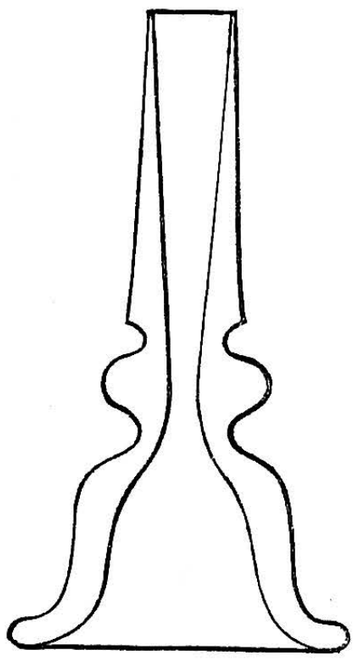


Cutting Tool.

Ladies' Combined Workbox and Travelling Case.—J. E. (*Notting Hill*).—It would be folly to rush haphazard at a conclusion respecting your letter, and give a design which might prove useless. I must place a few questions first. Do you require a workbox with accommodation for toilette requisites and other small items, which ladies know more of than their companions of the opposite sex do? or do you need a case for the reception of clothes and articles of that class? do you wish it to be made of wood or of leather? Say what it is destined to contain, and I shall be in a far better position to tender my advice and a design. Long letters, providing they do not depart from the description of the needs of a correspondent, are preferable to short ones. As an old subscriber, you will see I am taking the best course, at present; so please hurry up with your particulars.—J. S.

Bicycle Plating.—NITRATE.—I am quite unaware of any preparation of silver that will take the place of nickel-plating on a bicycle. I am quite certain there is no substitute that will either have the appearance or the durability of nickel-plating.—A. S. P.

Soldier's Trumpet.—ON PLEASURE BENT.—What our correspondent terms soldiers' trumpets are of two kinds—the regulation bugle used by infantry regiments and the regulation trumpet used by the cavalry. The former is of copper, with three turns—that is, the conical tubing is bent into three turns. The cavalry trumpet is a deeper-toned instrument, made of brass, with two turns. The mouthpieces are of cast brass, and are turned as shown in diagram. The penetrating or carrying power of the sound is due to the form and proportions of the instrument, and to the fact that the air column in the tubing is made to vibrate with considerable force by the performer, as the cup of the mouthpiece diminishes in diameter to an opening about $\frac{3}{16}$ in. across, through which the air has to be driven by the player. The long coach or tandem horns referred to by our correspondent are straight conical tubes tapering from $\frac{3}{8}$ in. to $4\frac{1}{2}$ in. in the 40 in. coach horn. There is no definite length for these instruments. The method of making these straight horns is to cut from the flat sheet brass or copper a strip of the required size and taper, and with a tool which resembles a punch to throw up on the one edge a series of little teeth, at about $\frac{1}{4}$ in. apart, and then bring the edges together, beating down the small teeth to hold them in position. Then solder, clean, and polish. It is usual to solder a piece of half round brass wire round the edge of the bell. The horn sketched by ON PLEASURE BENT is a *signal* horn used by railway guards, bicyclists, etc. The sound in these is produced by a small brass reed, on the same principle as in the concertina.—G.



Trumpet Mouthpiece.

Black Japan.—LEARNER.—I regret that I cannot inform you how to make the black varnish or japan sold by Docker Bros., not being in the confidence of that firm. If there is any specially good quality about it, you may depend they will keep the method of preparation a secret. Besides this, the manufacture of such things is risky and expensive; and I am sure it would pay you better to buy what you require, even if you knew how to make it.—R. A.

Barnes' Saw and Lathe.—C. P. (*London, N.W.*).—I have not actually seen Barnes' scroll-saw combined with circular, but I have seen their lathes, and heard them highly commended. I think you would get good value for your money. The No. 4 lathe is a slide-lathe, very good for small metal work. You do not want a slide-lathe for light cabinet work, for which I think No. 3 would be more suitable. If, however, you wish to work in metal as well as wood, have No. 4. It is impossible to say "what is the smallest amount it is necessary to go to for a serviceable machine," people's ideas differ so much as to what is serviceable; will not my remarks on p. 18 of Vol. I. help you to make up your mind? Your last question—as to motors—is fairly answered on pp. 22 and 23 of Vol. III. You can hardly expect WORK to tell you which maker to go to, because that would be giving a gratuitous advertisement. As writers, we try to be fair all round. You asked about Barnes, I therefore gave my opinion; but to ask me to recommend a maker is another matter. I may say, however, in addition to what you will find on p. 23, if you have a gas engine, have a compression one—say an Otto or Purnell; do not have a non-compression one. Gas engines are cheaper than they were a year ago. Remember, however, that if you must have a motor, you will also require shafting, a counter-shaft for each machine, with crossed and open belt, and striking gear to stop, start, and reverse. Motor may cost £30 and shafting £10.—F. A. M.

Telescope.—H. M. M. (*Bootle*) writes for instructions for making a telescope by which he could read the titles on the back of small books at a distance of 7 ft. or 8 ft. From the question, and also from the size of the writing, I judge H. M. M., like myself, is short-sighted. Seven or eight feet is not a long distance for ordinary sight. I, however, with concave glasses could not see under the conditions named. I think it would be folly in the extreme to make a telescope simply to meet such requirements. What I recommend is a cheap opera-glass or, better still, a pair of good spectacles. If H. M. M. will turn to WORK, No. 142, page 598, he will find the details of a telescope which will do what he wants. But if what he proposes doing is all he needs a telescope for, then I am afraid the results will hardly be worth the labour and cost; besides, from its length, a telescope would be unsteady to view objects so near. The binocular or opera-glass is to be preferred. A cheap one to answer the purpose indicated can be procured for a few shillings. If desired, I would give a few helpful hints for the construction of one.—O. B.

Wax Threads.—R. T. W. (*Leicester*).—You ask for hints on the above subject, and in this column it is all I can give you; but, seeing well the difficulty you are in, brevity shall not rob you of much, though, if you have well read my papers, you should not have bought "machine thread." You had better get a ball of No. 9 patent flax, a ball of wax (soft for cold weather, and hard for warm weather), and a halfpennyworth of bristles, and these you will find out how to put on to the thread when it is made by turning to p. 716, No. 149, Vol. III., of WORK, and reading my answer to A. H. (*Nottingham*). To make the threads, get the end of the flax from the inside of the ball, and hold it about a foot from the end on your right knee (or thigh), and roll it on it till you get to the knee. This, if you do not pull it too tight, will untwist it between the two hands, and by taking the end in the right hand (without letting it twist back again), holding it firm, and giving a sharp snap, it will break in two, leaving both ends flossy and tapered. The odd piece in the right hand you throw away. You then cut off about a yard and a half, and with it, at this juncture, repeat the above process. These two ends you put together, and follow it on till you reach the other end of the yard and a half; there you twist and break again, and also put the ends together. This process you keep up till you have what you want, say, nine cords. (Read up articles; various numbers are given for different kinds of work.) Each time you add one cord or strand to another, let it be a little below or a little above the other. This is to make a fine thin taper to receive the bristle. Now pass the whole through a little water to wet it, and pass it between the thumb and finger, to take away all superfluous water; then put the middle of it over a hook in a window-sill, hold one end in each hand, stand on your left leg, and rest the right on a stool, and twist the end in the right hand the same way as you did the flax in casting off. It does not want to be twisted too tight—about nine or ten times will do, but, whatever the number, count them, and twist the other end the same. Then put the two ends together, and rub them down briskly with a piece of rag. Take it off the hook, so as not to let it get into tangle. Let it dry, and it is ready to receive the wax. Have a piece of wax about the size of a walnut in the right hand, and in the left have the thread wound once round, with one end about 2 ft. long. Hold the left up in the air in front of you, put the right up to meet it, and catch hold of the part of the end near the left hand, letting it pass over the wax; close the hand, so that the thumb will keep it in its place on top of the wax. Hold the left hand firm, and draw the other down until it is liberated by there being no more end; repeat this two or three times till it has a nice thin layer on, and then serve the other part of the thread in the same way. Then wax the tapers (the extreme ends), twist them a little, and fix the bristles on as before described. Put the two ends together, twist

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them between the thumb and finger to tell you the centre, and they are ready for use.—W. G.

Two-Inch Spark Coil.—H. B. S. (*Wolverhampton*).—*Core* of soft annealed No. 20 iron wires made into a bundle 10½ in. in length by 1¼ in. in diameter. *Primary:* two layers of No. 16 silk-covered soft copper wire soaked in paraffin wax. *Secondary:* 3 lb. No. 38 silk-covered well-annealed copper wire wound in three divisions, the partitions being made of ebonite or of millboard soaked in paraffin wax. Each layer of secondary well insulated from the next by one fold of bank or foreign post paper soaked in paraffin. *Condenser:* 100 sheets of tinfoil, each 7 in. by 4 in. The battery power needed will be, probably, from 4 to 6 quart size Bunsen or chromic acid cells in series. Try four cells first; then add others as required. It is not "necessary to have the break hammer working up against the iron core." The break may be worked by means of a separate electro-magnet in the primary circuit away from the core, but it is usual to employ the magnetism of the cores of small coils to work the break hammer.—G. E. B.

Manchester Dynamo.—TINKER.—Wind the cores 4½ in. by 2 in. with 8 lb. No. 22 cotton-covered copper wire. As the space for the armature is 4 in. in diameter by 3¾ in. in depth, it will take a laminated cogged armature 3¾ in. in diameter by the same in thickness. The circumference of this will be 12 in., and this will divide into six notches of 1½ in. each, and six cogs of ½ in. each, the depth of the notches being ⅝ in. each. You will probably be able to get 3½ lb. of No. 20 double cotton-covered wire on this armature, or about forty-seven yards in each division. This, when driven at a rate of 2,000 revolutions per minute, should supply enough current to light one 20 c.-p. and two 16 c.-p. lamps, requiring from 25 to 30 volts each.—G. E. B.

Simplex Dynamo.—C. R. (*Camberwell*).—I wish you could have given me the measurement of the armature tunnel, and also told me the kind of work you wished to do with the machine. The term "large ampèreage current" is rather vague, as you do not say the resistance of the outer circuit through which you wish to get a large volume of current. If you wish to get a large volume of current from your machine at a low tension, you must wind the armature with coarse wire, say No. 18 or No. 16. A drum armature is most favourable to the production of large volumes of current, since the resistance of the coils is lower than that of the shuttle form. In a series-wound machine, the resistance of the wires on the fields must be two-thirds that of the armature coils. In a shunt-wound machine the resistance of the fields must be 400 times that of the armature coils. The resistance of the armature coils should be one-twentieth the resistance of the outer circuit or work to be done by the machine.—G. E. B.

Plumbers' Metal.—AMATEUR.—I do not know of any special mixture for use without irons or blowlamp. If you are making joints in the workshop, it is quite possible to make a joint with only a ladle of metal and a splash-stick, if you have metal enough, and have the knack of keeping up the heat. A mixture of two parts lead and one part tin will make a good solder for the purpose. The best book I know of for practical plumbing is by P. J. Davies (Spon). Watch for papers in WORK.—R. A.

Hot-Water Pipes, Care of.—J. T. H. (*South Shields*).—The only thing you can do is to either keep your fires in or run all the water out. You will find that large pipes are not so likely to freeze as small ones. Any pipes that are not actually in the building you might lap round with felt, as a help towards the desired end.—R. A.

Sheet-Metal Pattern Books.—A. W. (*Warrington*).—There are several manuals for the use of tin and other metal-plate workers, but you will find that none of them are so simple that you will understand them without any study. The best book that I can recommend you is C. T. Millis' "Sheet-Metal Work" (Spon). The one you refer to was, no doubt, Warne's, a book once deservedly a favourite, but not, in my opinion, equal to Millis'.—R. A.

Polishing Gilders' Agate Burnisher.—TIP.—In the removal of the flaw, have you not also altered the shape? And even if you have not, the best and cheapest way will be to get a lapidary to re-polish it; it will cost but a few pence. If you cannot send it to be done in the best way, you might succeed in getting a good surface on it by making a wooden disc to run on a lathe. On the front of the disc should be fixed as much selvage of cloth as will just cover it; the selvage to be coiled up as ribbon is, and glued on; this is called a "list lap." Make another wooden disc, and cover that with leather; this is called a "leather lap." When dry, the agate can be polished by subjecting it to the list lap, charged with powdered pumice and water; then to the leather lap, charged with putty-powder. As a rule, a great amount of friction is required, and a lathe is the only easily available method of obtaining it; but in your case a leather buff charged with putty-powder might suffice. You might try that first. If you make any laps, 3 in. or 4 in. diameter will probably be large enough for polishing the general run of burnishers.—H. S. G.

Model Boiler Lamp.—W. Y. S. (*South Shields*).—You had better send particulars of your requirements to Mr. Caplatzi, who advertises in WORK, if there is no one in your town to sell a suitable lamp. You can buy the right thing far cheaper than you could make something that would prove to be useless.

III.—QUESTIONS SUBMITTED TO READERS.

*** *The attention and co-operation of readers of* WORK *are invited for this section of "Shop."*

Soldier's Box.—W. G. (*Leeds*) writes:—"Could any of my fellow-readers oblige me with a design for a useful box suitable for a soldier to keep his private property in in the barrack-room?"

Almanack.—A. R. (*Moseley*) will thank any reader to inform him of an almanack that would give the difference upon any day of the year between solar and clock time in order to set a sundial.

Auto-Harp.—MUSIC writes:—"Will a kind reader inform me how to make an auto-harp?"

Tobacco Box.—T. P. (*No Address*) writes:—"Will someone kindly tell me how to make a tobacco box of brass, opening with a lid on the top, hinges at the back, and spring in front?"

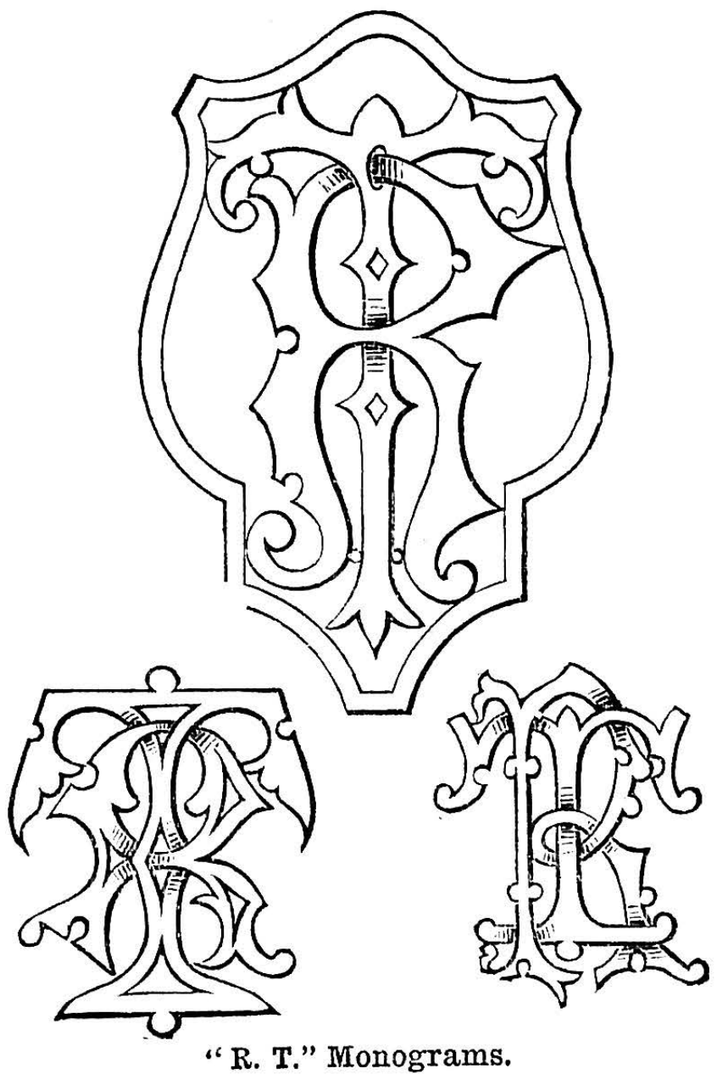
Fowls' House.—B. W. L. (*Leominster*) writes:—"I want to build a span roof fowls' house on wheels. I have some 3 in. square wood for frame. Would some kind reader inform me the best and easiest way to join framework, leaving 18 in. space under floor for shelter; also best wheels to use?"

Boat.—W. J. H. (*Govan*) writes:—"Would any reader oblige by giving me a sketch of a boat, 3 ft. long, built for frames of either wood or light sheet iron? I intend to use steam power."

Polishing Oak Bookcase.—DOC writes:—"Will anyone kindly answer me the following questions:—(1) Best liquid stain, not too dark, for oak? (2) Directions for polishing with beeswax and turpentine, and is it necessary to use a filling for the grain, and if so what material to use? (3) Would the above method of polishing be suitable for a large bookcase?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

"R.T." Monogram.—R.D.T. (*Marylebone*) writes:—"I send three designs of monogram, 'R. T.,' as wished for by R. T. (*Glasgow*) (see No. 174, page 286). The larger one of the three is a design which I have



"R. T." Monograms.

used myself and in that size; but our correspondent can easily reduce or enlarge it to suit his requirements. I, however, trust that he will find one of the designs to suit his purpose, but if not I shall be pleased to send further designs of the same monogram."

Telephone Connection.—J. B. (*New Cross*) writes to A. S. B. (*Loughborough*) (see No. 172, page 254):—"The best way, and easiest, to enable your man working outside your building to know if the telephone bell has rung or is ringing inside would be to cut the telephone wire just as it is leaving one of the bobbins of the electro-magnet of the bell, taking great care not to interfere with the switches, drop connections, etc., of the telephone itself, and fasten the two ends of your new line to the two new ends thus made by cutting; carry your lines through the house with, say, No. 16 B.W.G. double cotton-covered wire, and on the outside with the same covered with gutta-percha; to the other free ends of your new line connect up a small bell with a drop indicator, which can be obtained of any dealer in bells, etc. The inside bell and the outside one will now ring in series and at the same time; if your man has not heard the outside bell, the indicator will show him that it has rung. If the line of your telephone is a private one, you will find this all that you require. If the line belongs to a company, well—perhaps, you had better think about it. Only do not say I told you how to do it."

V.—LETTERS RECEIVED.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—F. P. (*Birmingham*); J. D. MCA. (*Manchester*); PARING KNIFE; F. H. (*Aynho Station*); J. R. (*Canterbury*); H. E. S. (*Chatham*); W. T. T. (*Houghton-le-Spring*); COAT OF ARMS; W. S. (*Chelsea*); J. M. (*No Address*); T. R. (*Ashton*); W. M., JUNR. (*Dundee*); T. B. (*Haydock*); SUBSCRIBER; CANADA; G. S. (*Guernsey*); G. B. (*Elmstead Heath*); L. M. (*Lee*); J. M. (*Nantwich*); J. P. H. (*Hull*); H. S. (*Maidstone*); O. B. (*Wood Green*); R. P. (*Stoke-on-Trent*); DRILLER; H. A. B. (*Middlesbro'*); A. S. (*Epping*); E. E. (*London*); R. J. A. (*Dublin*); G. D. (*Holloway*); PROGRESS; A. E. B. (*Ashford*); GOLD; W. M. (*Bray*); AMATEUR BOOKBINDER; CYCLIST; P. H. Z. (*Hammersmith*); LITTLE JIM; J. B. (*Brigg*); A. S. (*Burnley*); R. S. D. (*Cambuslang*); NOVICE; W. T. (*Southsea*); H. D. (*North Shields*); READER OF "WORK."

"WORK" PRIZE SCHEME.

FOURTH COMPETITION.

"Tourists' Road, Water, or Rail, Travelling Requisite" Competition.

To give zest to, and widen the field of original research, such an outfit might, for instance, combine with it some useful appliance to be used in case of emergency—such as life-saving, or in pleasure hunting while holiday bent. This we must leave to our readers' judgment, and feel sure that anything to make travel more enjoyable will be welcomed by the public and the readers of WORK who have to travel. By the time this announcement is made most of us will have had some experience of holidays and the pleasures (?) of luggage. For the three best suggestions for an "Improved Tourists' Travelling Requisite," the following prizes will be awarded—

First Prize, £3;
Second Prize, £2;
Third Prize, £1.

CONDITIONS AND RULES OF THE "TOURISTS' TRAVELLING REQUISITE" COMPETITION will be found in No. 181 and subsequent issues.

All manuscripts intended for the "Tourists' Travelling Requisite" Competition must be addressed to the Editor of WORK, c/o Cassell and Company, Ltd., Ludgate Hill, London, E.C. They must reach him on or before SATURDAY, OCTOBER 29, endorsed, "Tourists' Travelling Requisite" Competition.

"WORK" WEEKLY CONTENTS.

SEVERAL subscribers have kindly made the suggestion to exhibit a weekly contents bill of WORK in their workshops and elsewhere, for the benefit of fellow-workmen not already subscribers.

Doubtless many others who write expressing their indebtedness to WORK may be similarly disposed. If so, and they will furnish their names and addresses to the Editor, such a bill for exhibition will be sent to them by Messrs. Cassell & Co.

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